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SOILS OF THE TRUELOVE LOWLAND AND VICINITY, DEVON ISLAND, N.W.T.

by

© BRUCE DAWSON WALKER

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF SCIENCE

DEPARTMENT OF SOIL SCIENCE

EDMONTON, ALBERTA

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THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled "Soils of the Truelove Lowland and Vicinity, Devon Island, N.W.T." submitted by Bruce Dawson Walker in partial fulfilment of the requirements for the degree of Master of Science.

ABSTRACT

The Truelove Lowland and adjacent upland to the east were investigated to determine kinds and distribution of soils. The tentative Cryosolic Order was used to classify the soils to the subgroup level. Further separations approximating the soil series level of abstraction were based on parent material characteristics. Distributions of soil map units, based on the "soil series" or complexes of "soil series", are depicted on an orthophoto mosaic base with a scale of approximately 1:15,000.

The study area encompasses coastal lowland, not unlike sedge-grass tundra of the Low Arctic, and interior plateau or upland that resembles Polar Desert areas of the High Arctic. Consequently, soil cover of the Lowland is much more complex than that of the upland. Soil subgroups correlate best with drainage and vegetation patterns until severely restricted drainage conditions are encountered.

Soils with relatively free drainage (rapidly to moderately well drained) include Regosolic Static Cryosols (Ahk-Ck-Cz horizon sequence) and Brunisolic Static Cryosols (Ahk-Bmk-Ck-Cz horizon sequence). These soils are associated with cushion plant-lichen, cushion plant-moss, and dwarf shrub heath-moss plant communities and occur on raised beaches and in small, warm habitats of crystalline rock outcrops.

Imperfectly to poorly drained soils include Regosolic Turbic Cryosols, Brunisolic Turbic Cryosols, and Gleysolic Turbic Cryosols that are associated with cushion plant-lichen and cushion plant-moss communities with frost-boils and frost-boil sedge-moss meadow community. Raised beaches, Lowland moraine, and undifferentiated plains are landforms in which these soils of patterned ground meshes (circles, nets, or stripes) develop. A Gleysolic Turbic Cryosol that lacks organic matter accumulation mantles the upland portion of the study area and is associated with moss-herb (Polar Desert)

vegetation.

Wet soils (poorly to very poorly drained) include Gleysolic Static Cryosols (Of-Ckg-Cz horizon sequence) of undifferentiated plains, Lowland moraine, floodplains, and alluvial-lacustrine plains and Fibric Organo Cryosols (Of-Oz horizon sequence) of undifferentiated plains. Hummocky sedge-moss meadow and wet sedge-moss meadow are characteristic plant communities. A drier Glacic Fibric Organo Cryosol mantles high-centered, ice-cored, ice-wedge polygons.

Miscellaneous soil map units include unconsolidated, fragmental beach, outwash, alluvial, colluvial, and morainal deposits and two types of bedrock.

Generally, soils of the study area are alkaline, calcareous, base saturated, nonsaline, and coarse textured (sandy loam to sand) with variable coarse fragment contents. Organic layers and soils are generally quite fibrous and slightly acid to neutral in reaction.

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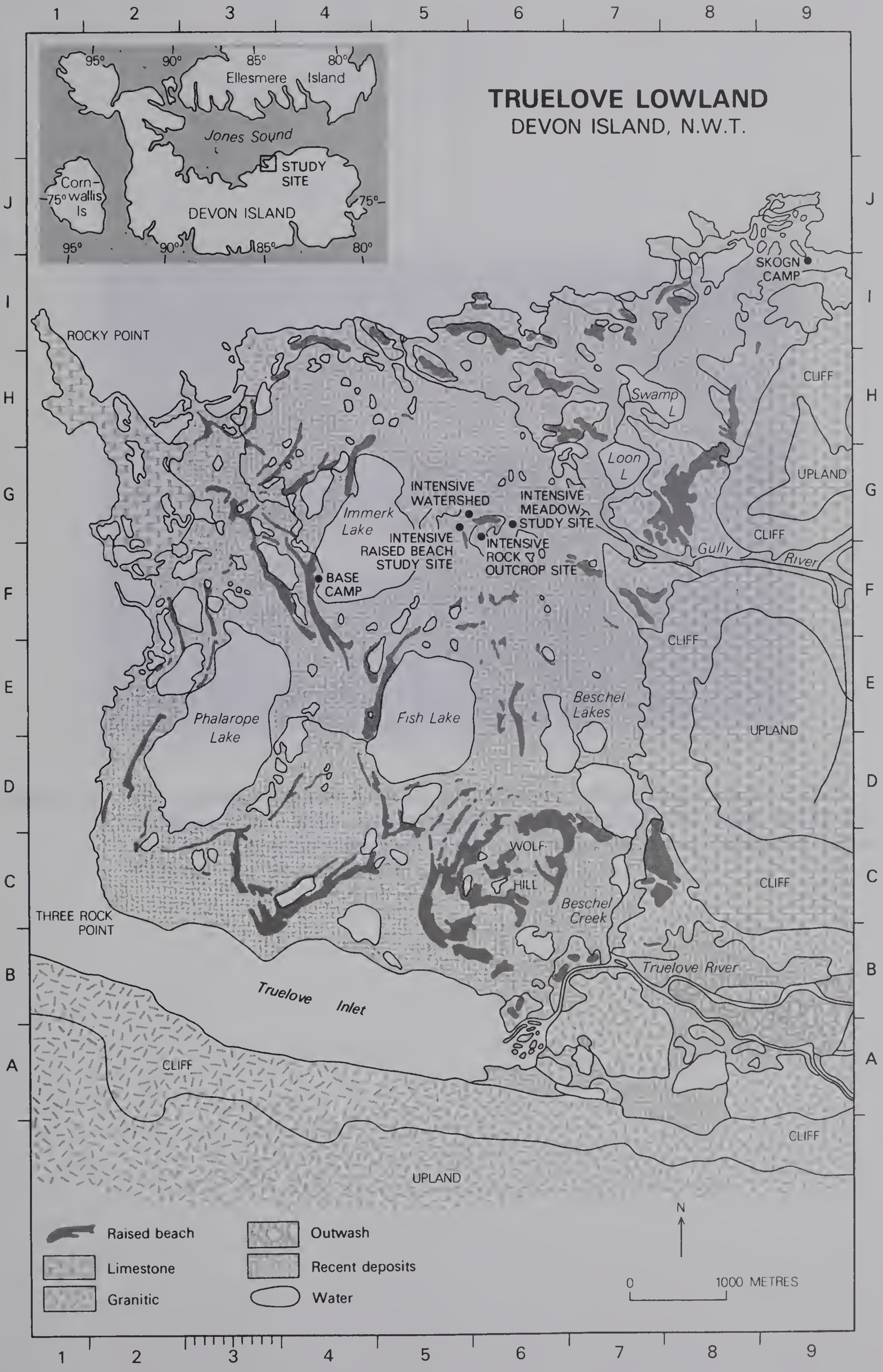
INTRODUCTION

To aid in knowledge aquisition of High Artic environments, a detailed ecological investigation, directed within the framework of the International Biological Programme (IBP) and under the auspicies of the Canadian Committee for the International Biological Programme (CCIBP), was conducted on the northeast coast of Devon Island, N.W.T. The study area (Fig. 1), encompassing the Truelove Lowland (Plate 1) and a small part of the plateau (or upland) to the east, centers on latitude 75° 33' N and longitude 84° 40' W.

The prime objective of this soils investigation, an integral part of the total ecological study, is to depict local distribution of soils within the Truelove Lowland and adjacent upland to the east. Significant mapping problems were overcome through: 1) recognition of frost disturbance as a pedogenic factor; 2) adherence to the pedon concept (Soil Survey Staff 1960) as specified for northern soils (Canada Soil Survey Committee 1973); and 3) use of a tentative classification system for northern soils -- the Cryosolic Order (C.S.S.C. 1973). Consequently, mapping difficulties are reduced to dependence upon complexities in parent material types and vegetation and drainage patterns. Such complexities exist on the Truelove Lowland sector of the study area. Soil map units relate, via legend format, soil subgroup classes (C.S.S.C. 1973) with parent materials, drainage patterns, periglacial features, and plant community types.

A secondary objective is to characterize some of the major or significant soils of the study area. Profile descriptions and accompanying analytical data of sampled profiles, considered to be representative of certain map units, facilitate this aim.

Figure 1. Map of Truelove Lowland and key map. Accepted place names and IBP intensive study site locations are shown.


TRUELOVE LOWLAND
DEVON ISLAND, N.W.T.
95°
90°
85°
80°
Ellesmere Island
Jones Sound
STUDY SITE
Corn-wallis Is
75°
DEVON ISLAND
ROCKY POINT
SKOGN CAMP
Swamp L
Loon L
CLIFF
UPLAND
Immerk Lake
INTENSIVE WATERSHED
INTENSIVE MEADOW STUDY SITE
INTENSIVE RAISED BEACH STUDY SITE
INTENSIVE ROCK OUTCROP SITE
BASE CAMP
Gully River
Phalarope Lake
Fish Lake
Beschel Lakes
WOLF HILL
Beschel Creek
THREE ROCK POINT
Truelove River
Truelove Inlet
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
I
J
Raised beach
Limestone
Granitic
Outwash
Recent deposits
Water
N
0
1000 METRES

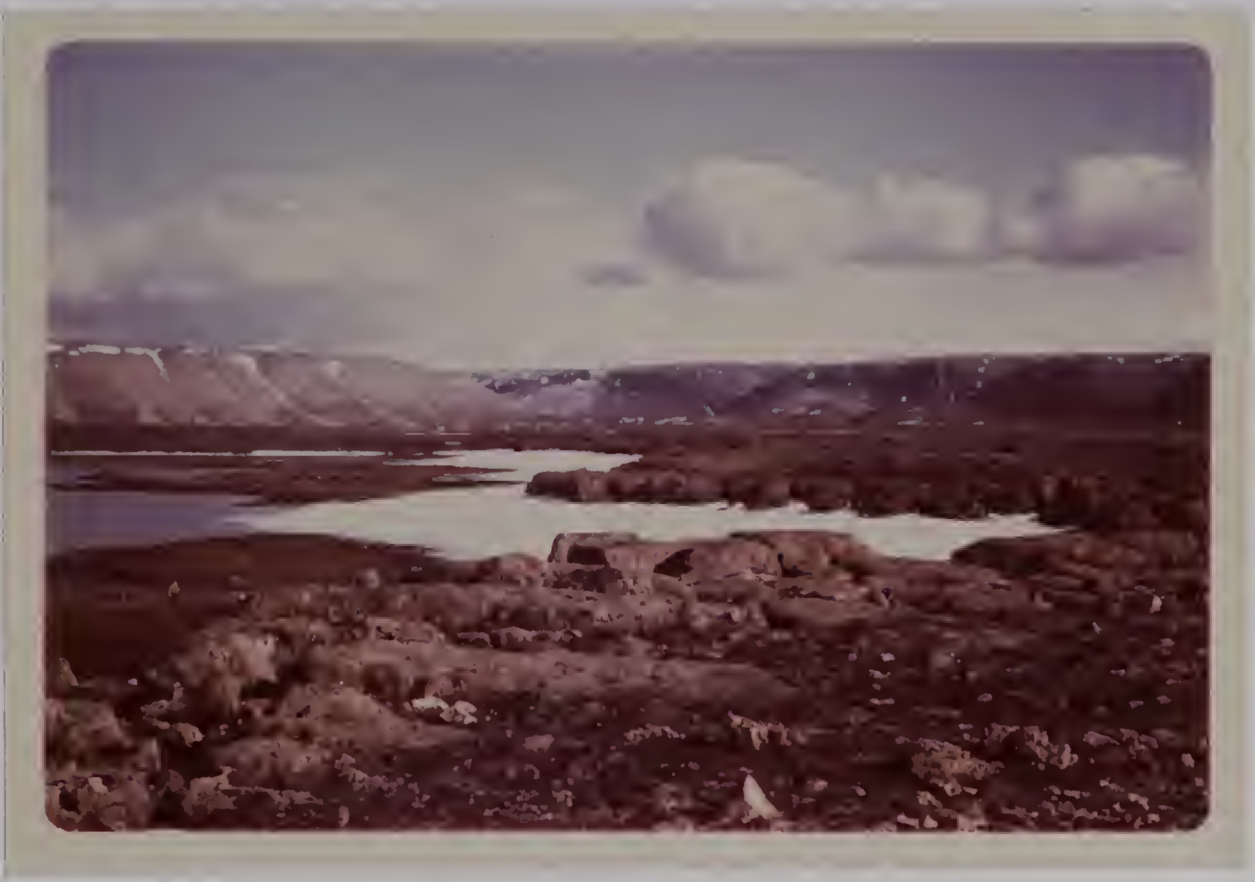


Plate 1. Photograph of the Truelove Lowland. View from Rocky Point looking SE. Note the dark-colored crystalline rock cliff to the S (right background) and the light-colored dolomite scree "cliff" to the E (left background).

Environmental factors determining local pedogenic trends are briefly explored. Of particular note are soil-drainage-vegetation relationships.

Soil survey and sampling work was undertaken during the summer seasons (July and August) of 1971, 1972, and 1973. Laboratory investigations were completed by 1975.

LITERATURE REVIEW

The following comprehensive literature survey primarily provides the setting for comparison of soil features and pedogenic trends and for the application of a new soil classification system (C.S.S.C. 1973) in the study area. A factor in determining the wide geographic range of literature sources is the uniqueness of the largest part of the study area -- geographically High Arctic but with many Low Arctic (or Tundra belt) affinities (Bliss 1975b). Further, this review is an attempt to correlate a variety of studies and views on arctic soils and environments.

From early and general descriptions (Glinka 1927, 1963, Joffe 1949, Buckman and Brady 1960, Gerasimov and Glazovskaya 1965) arctic soils are impressed upon the mind as being cold, somewhat compacted, mineral-gley (bluish-grey) soils underlain, at variable depths, by perpetually frozen ground (permafrost) and overlain by variable thicknesses of organic (peaty) or, on occassion, organo-mineral layers. Frequently termed Tundra soils, they occupy wet arctic grasslands (Odum 1971). Extensive areas of organic (bog) soils are associated with arctic regions (Leahey 1969). Bog or boggy, marshy, tundra, gley, and weak podzolic are terms that have been used in attempts to identify types of soil formation in arctic latitudes (Glinka 1927, 1963, Joffe 1949, Gerasimov and Glazovskaya 1965).

Associated with many arctic areas are patterned ground (Washburn 1956, 1973) features caused by cryogenic or periglacial processes and manifest by the disruption of horizontal continuity and vertical horizonation. Numerous terms (spotted tundra, hummocky tundra, spot or frost medallions, polygonal tundra, frost-boil tundra, mud-boils to list only

a few examples) that describe these phenomena have arisen in the literature.

Much information concerning soils of Soviet and North American arctic regions has been collected since 1950. So-called genetic soil types (Great Soil Groups) have been recognized and qualitative pedogenic processes contemplated (Kreida 1958, Tedrow and Cantlon 1958, Ignatenko 1965, Rozov and Ivanova 1968). Pedologists now discuss genetic soil types and pedogenic gradients in terms of biogeographic or pedogenic zones that have been imposed upon the Arctic.

Biogeographic and Pedogenic Zoning of Arctic Regions

Table 1 represents an attempt at relating biogeographic and pedogenic zones of the Arctic according to various authorities on soils and vegetation of the north. Confusing terminology and concepts, resulting from lack of cooperation among disciplines and nations and from the size, complexity, and continental differences of arctic regions, have made this exercise difficult and perhaps inaccurate at critical boundaries.

With few exceptions, Soviet investigators base pedogenic zonation upon broad vegetation types (or zones) and recognize a relatively detailed zone-subzone-belt breakdown of the Eurasian arctic. Major problems arise in discerning boundary conditions between the Tundra zone and Polar Desert or Arctic Desert zone. Some authors (Ivanova *et al.* 1961, Targulyan and Karavaeva 1965) do not recognize a cold desert or semi-desert belt within the Eurasian arctic. Targulyan and Karavaeva (1965) feel that such a condition belongs to the Antarctic only. Regardless of individual differences, classification of soils of the Eurasian arctic is based upon the recognized ecological zones.

Table 1. Biogeographic and pedogenic zones of circumpolar regions (based on Aleksandrova 1970).

<table>
<tr><th rowspan="2"></th><th colspan="2">Polar Desert Zone</th><th colspan="5">Tundra Zone</th></tr>
<tr><th colspan="2"></th><th colspan="2">Arctic Tundra Subzone</th><th colspan="3">Subarctic Tundra Subzone</th></tr>
<tr><td>Aleksandrova 1970</td><td>Subzone of the northern variant of polar desert</td><td>Subzone of the southern variant of polar desert</td><td>Northern variant subzone (belt)</td><td>Southern variant subzone (belt)</td><td colspan="2">Subzone (belt) of typical tundra</td><td>Subzone (belt) of southern tundra</td></tr>
<tr><td>Gorodkov[1] 1954</td><td colspan="3">Arctic Deserts</td><td>Arctic tundras</td><td colspan="2">Typical (moss-lichen) tundras</td><td>Shrub and tussock tundras</td></tr>
<tr><td>Andreev[1] 1966</td><td colspan="2"></td><td>Subzone of arctic semi-deserts</td><td>Subzone of arctic tundras</td><td colspan="2">Subzone of northern tundras</td><td>Subzone of southern tundras</td></tr>
<tr><td rowspan="2">Kreida 1958
Ignatenko 1965</td><td colspan="3" rowspan="2">? — — —</td><td colspan="4">Tundra Zone</td></tr>
<tr><td>Arctic tundra subzone (Moss-sedge)</td><td colspan="2">Typical or northern tundra subzone (Moss-lichen)</td><td>Southern or bush tundra subzone (Bush-moss-lichen)</td></tr>
<tr><td rowspan="2">Ivanova et al. 1961</td><td colspan="3" rowspan="2">Arctic Zone ? — — —</td><td colspan="4">Tundra Zone</td></tr>
<tr><td>Moss-grass subzone</td><td colspan="2">Moss-lichen-subzone</td><td>Moss-shrub subzone</td></tr>
<tr><td rowspan="2">Liverovskii 1965</td><td colspan="3" rowspan="2">Arctic desert and semi-desert - Arctic soils ? — — —</td><td colspan="4">Tundra Zone</td></tr>
<tr><td>Arctic tundra subzone</td><td colspan="2">Moss-lichen tundra subzone</td><td>Bush-tundra subzone</td></tr>
<tr><td rowspan="2">Targul'yan and Karavaeva 1965</td><td colspan="3" rowspan="2">Arctic Zone ? — — —</td><td colspan="4">Tundra Zone</td></tr>
<tr><td>Arctic tundra zone</td><td colspan="2">Typical tundra subzone</td><td>Southern tundra subzone</td></tr>
<tr><td>Polunin 1951</td><td>High Arctic</td><td colspan="2">Mid Arctic</td><td colspan="4">Low Arctic</td></tr>
<tr><td>Tedrow 1973a, 1973b</td><td>Polar Desert Soil Zone (High Arctic)</td><td colspan="2">Subpolar Desert Soil Zone (Mid Arctic)</td><td colspan="4">Tundra Soil Zone (Low Arctic)</td></tr>
<tr><td rowspan="2">Bliss et al. 1973
Bliss 1975a</td><td colspan="3" rowspan="2">High Arctic
-encompassing a mosaic of: 1. Poplar desert, 2. Polar semi-desert, and 3. Wet sedge-grass tundra.</td><td colspan="4">Low Arctic</td></tr>
<tr><td>Wet sedge and grass tundra</td><td>Cotton grass-sub shrub tundra</td><td>Low shrub-sub shrub tundra</td><td>Tall shrub tundra</td></tr>
</table>

[1] Taken directly from Aleksandrova (1970).

Pedogenic zonation and soil classification are not as rigidly related in North American circles. Primary emphasis has been placed on broad bio-climatic zones which evolved through a more holocoenotic approach to zonation. Thus soil zonation of the North American Arctic followed the establishment of the major soil types (Great Soil Groups).

With respect to the North American Arctic it must be conceded that there occur at least two distinct bio-climatic zones (Polunin 1951, Porsild 1951, Rae 1951). These are (1) the Low Arctic (Bliss *et al.* 1973, Bliss 1975) or Tundra Soil Zone (Tedrow 1973a, 1973b) which primarily encompasses that portion of the mainland of Canada and Alaska occurring north of the northern extension of coniferous tree growth and, (2) the High Arctic (Bliss *et al.* 1973, Bliss 1975a) incorporating Tedrow's (1973a, 1973b) Polar Desert and Subpolar Desert soils zones and encompassing the islands of the Canadian Arctic Archipelago and much of Greenland. The Low Arctic is dominated by mineral gley soils and displays four vegetational subzones (Bliss *et al.* 1973, Bliss 1975a). The High Arctic displays a mosaic of vegetation and soils, not climatically controlled latitudinally but influenced in part by local or sub-regional climatic conditions and in part by moisture regime as influenced by local topography (Bliss *et al.* 1973, Bliss 1975a).

On a world wide basis, but with the exception of Soviet investigators, the concept of zonality as applied to pedogenesis and soil classification is no longer in vogue. The Arctic provides an excellent example of the breakdown of principles underlying this concept, originated by Dokuchaev and Sibertzev (in Glinka 1927, Joffe 1949) and further developed by Marbut (in Tedrow and Cantlon 1958).

A zonal soil is considered to be coincident with a climatic zone,

thereby implicating regional climate as the major soil forming factor (Joffe 1949). The normal (zonal) profile is defined by Marbut (in Tedrow and Cantlon 1958) as occurring on land of normal relief (relief that characterizes the greater part of the earth's surface) and under conditions of normal good drainage. Using drainage as the focal point, Tedrow and Cantlon (1958) designated Tundra (gley) soils (Tedrow and Cantlon 1958, Tedrow *et al.* 1958, Douglas and Tedrow 1960), dominant in the Low Arctic, as immature, hydromorphic soils. The rarely occurring but well-drained Arctic Brown soils (Tedrow and Hill 1955, Drew and Tedrow 1957, Tedrow and Cantlon 1958, Tedrow *et al.* 1958, Tedrow 1968) were designated as the zonally normal soils of the Low Arctic. Yet Arctic Brown soils do not occur on land of normal relief and reflect, only partially, regional climate. They also occur, with about the same regularity, in the High Arctic. Full realization of this contradiction of principles arrives with Tedrow and Cantlon's (1958) statement that "the operation of regional climate (relative to Tundra soils) brings about its own suppression as a soil-forming factor through the formation of the impervious frozen layer".

Based on areal dominance, Tundra soils characterize the Tundra Soil Zone and Polar Desert soils the Polar Desert and Sub-polar Desert Soil Zones (Tedrow 1973a, 1973b). He also depicts the circumpolar distributions of these three zones.

Arctic Soil Classification, Characterization, and Genesis

Major classification schemes for soils of the Arctic have been developed using concepts of zonality and pedogenic trends attained through work and experience in temperate latitudes.

The section of the Soviet soil classification system pertaining to arctic soils rigidly follows the concept of zonality (Kreida 1958, Ivanova *et al* 1961, Gerasimov and Glazovskaya 1965, Ignatenko 1965, Liverovskii 1965, Targul'yan and Karavaeva 1965, Rozov and Ivanova 1967a, 1967b, 1968, Aleksandrova 1970). Two genetic soil types (approximating Great Group in North American circles), based on the loosely defined Arctic and Tundra ecological zones (Table 1), are recognized. Soil subtype separations often reflect ecological subzones or belts and/or alterations in the hydrothermic and hydrological regimes as indicated by associated processes of accumulation and transformation of organic matter and processes of migration of mobile substances in the solum (Rozov and Ivanova 1967a, 1967b, 1968). Further subdivisions (genera and species) are based upon rather specific soil properties (eg. peculiarities of parent rock or the composition of ground waters) and quantitative grades of processes and phenomena. Soil varieties, categories, and phases are generally based on textural subdivisions, petrographic peculiarities of rocks, and degrees of erosion and deflation modification, respectively.

Consequently, the nomenclature given for any soil individual is essentially a word model describing its ecological location and pedogenic features including their degree of expression. As an example Ignatenko (1973) describes and characterizes a "tundra mouldy-gleyey impregnated (or saturated)-humus (humic) soil of Nano-Hummocky (small hummocky) Dryadic-Sedge Moss Tundra". This soil is essentially a gleyed mineral soil of the Tundra zone that displays mould in the A horizon and mobile humus throughout the solum. An essential characteristic to both the classification and the mapping (map in Matveyeva *et al*. 1974) of this

soil is that it occurs under *Dryas* - sedge moss small hummocky tundra. To illustrate the detail or scale of this system, the above soil occurs in intimate association with seven other similarly classified soils under this plant association (*sensu* Matveyeva *et al.* 1974) and rarely occupies more than 1 m, continuously, in the lateral dimension.

This system appears to lack specific, consistent separation criteria and is useful only to those having related experience and familiarity with its terminology. Although presented as a genetic system (Rozov and Ivanova 1967a, 1967b, 1968) the Soviet soil classification scheme, particularly as applied to arctic soils, has a strong ecologic-botanic bias which makes difficult a comparison of soils occurring under broadly similar environmental conditions (ie. wet mineral soils of Arctic and Tundra zones).

The major system for North American arctic soil classification was developed *ca.* 1955, by J.C.F. Tedrow, his colleagues and students. This scheme appears to be based upon the larger one of Baldwin, Kellogg, and Thorp. From work on the Arctic Slope of Alaska and in the Brooks Range, six major genetic soil groups (Great Soil Groups) plus intergrades (subgroups) were established (Tedrow and Hill 1955, Drew and Tedrow 1957, Tedrow *et al.* 1958, Douglas and Tedrow 1960, Hill and Tedrow 1961, Tedrow and Brown 1962, 1967, Brown and Tedrow 1964, Brown 1966, Rieger 1966). Using the Arctic Brown group as the central or focal point, two groups (Tundra and Bog soils) were defined by increasing wetness, a fourth group (Polar Desert soils) by weakening of the soil-forming potential, a fifth group (Lithosols) by increasing shallowness to bedrock, and the final group (Regosols) by increasing coarseness of materials (Tedrow and Cantlon 1958).

Studies in Canada's arctic islands and in Greenland (Tedrow 1966, Ugolini 1966a, 1966b, Everett 1968, Tedrow *et al.* 1968) indicated that these six soil groups also exist in the High Arctic. Owing to these and more recent studies Tedrow (1970, 1973a, 1973b) added two more genetic soil groups, "Soil of the Hummocky Ground" and "Soil of the Polar Desert-Tundra Interjacence".

Many pedologists discuss qualitative genetic processes in terms of pedogenic gradients across polar regions (Tedrow and Cantalon 1958, Tedrow 1966a, 1968). In this vein soils of freely drained sites from south to north are compared. These are the Arctic Brown soils of the Tundra Soil Zone and Polar Desert soils of the Sub-Polar Desert and Polar Desert Zones (Tedrow 1973a, 1973b).

The type of development resulting in strong brownish sola and labelled Arctic Brown soil is considered to reflect weakening of the podzolization process (Tedrow and Hill 1955, Drew and Tedrow 1957, Tedrow and Cantlon 1958, Tedrow *et al.* 1958, Hill and Tedrow 1961, Karavayeva *et al.* 1965, Brown 1966, Ugolini 1966a, Tedrow 1968, Holowaychuk and Everett 1972). In fact, "podzol-like" soils - in most cases so termed because of the presence of eluvial A horizons - have been reported for southern fringe areas of the Tundra belt (Tedrow and Hill 1955, Kreida 1958, Tedrow *et al* 1958, Hill and Tedrow 1961, Ivanova *et al.* 1961, Ignatenko 1963, 1965, Day and Rice 1964, Gerasimov and Glazovskaya 1965, Karavayeva *et al.* 1965, Brown 1966, Ugolini 1966a, James 1970, Holowaychuk and Everett 1972, Tedrow 1973b). Such rarely occurring soils are usually developed in coarse-textured materials having relatively free drainage. Chemical processes operating during formation of both Arctic Brown and "podzol-like" soils of the Tundra Zone include increases in acidity

(marked in surface horizons), solution of carbonates, and a low order mobilization and translocation of Fe and Mn in the surface horizons of some soils (Brown 1966).

Arctic Brown soils of the High Arctic (Sub-Polar Deserts and Polar Desert Zones) display morphologies similar to their Tundra belt counterparts -- A-B-C horizon sequences, brownish sola, a decrease in organic matter content with increasing depth, increasing pH with increasing depth, and a decrease in clay and silt content with increasing depth (Tedrow and Douglas 1968). However, Arctic Brown soils of the more arid High Arctic have typically high pH values throughout their sola and often display pedogenic carbonate accumulation within the soil body (Tedrow and Douglas 1968, Tedrow 1973b). Consequently, recognition of a very weak podzolic soil-forming process for such soils has been questioned (Mikhaylov 1961, Tedrow and Douglas 1964). Mikhaylov (1961) suggests that the brownish color and acid reaction of Arctic Brown soils is related to the nature of the humus and the biogeochemical reactions involved in its accumulation and migration in the solum. Everett (1968) proposes that the prevailing process in such soils is calcification.

In retrospect, certain pedogenic process terms as listed and defined by Buol *et al.* (1973) can credibly be applied to Arctic Brown and related soils of all arctic regions. These are calcification, humification, melanization, and, in some cases or to a limited extent, braunification.

Although soils with similar morphology have rarely been described for Eurasian arctic regions, "Arctic sod soils" (or sod Arctic soils) recorded by Svatkov (1958), Mikhaylov (1960) and Ivanova *et al.* (1961) may be analogous to Arctic Brown soils.

Pedogenic processes operating within Polar Desert soils have re-

ceived comparatively little attention. Tedrow (1968) implies that the podzolization process is at its weakest in the development of these soils. He further indicates that calcification, alkalization, and salinization are prevailing processes. Everett (1968) suggests that salinization replaces calcification as the dominant process at roughly 70°N latitude. Day (1964) points out that there is no significant development of genetic horizons in the soils of the Lake Hazen area (about 82°N latitude). Yet Tedrow (1966b) describes two Polar Desert soils on Banks Island that display marked color differentiation among horizons and have relatively strong colored B horizons. Theories on such coloration were not offered.

It becomes apparent that the Polar Desert Soil Group is quite broad in its concept. Polar Desert soils are generally described (Tedrow 1966b, 1968, 1973b) as dry mineral soils with desert pavements and brownish sola but lacking humic coloration. Organic matter of the surface horizon (usually less than 1%) is thought to be contributed by lichens, algae, and diatoms. Precipitation of carbonates on the undersides of rock fragments is common throughout their sola. In addition to high pH values and base saturation, many have developed some degree of salinity.

King (1969) studied pedogenesis of a Polar Desert soil on Truelove Lowland, Devon Island. Although displaying humic surface horizons that do not meet the concept presented for Polar Desert soils by Tedrow (1966b, 1973b), this soil did have silty "cutanic" caps above and carbonate crusts beneath some of the larger coarse fragments. In a micropedological investigation of some profiles from Truelove Lowland, Devon Island and the coastal region of King Christian Island, Pawluk and Brewer (1975) concluded that freeze-thaw cycles dominated soil-forming processes at the Devon

Island sites whereas the soil from King Christian Island reflected processes of desalinization and alkalization.

Although changes across climatic gradients are less evident visually, gley soils can also be followed northward (Tedrow 1968).

Tundra soils, areally dominant in the Tundra Zone or Low Arctic, are wet mineral soils that usually display peat accumulation, acidity in surface horizons, and prominent gley colors sometimes with mottles (Tedrow and Cantlon 1958, Tedrow 1968, 1973b). Tundra soils of the High Arctic, reduced considerably in distribution, are characterized by shallower profiles, shallower accumulations of peat, neutral to aklaline reactions, and a lack of gley colors and mottles (Tedrow 1968, 1973b). The principal soil-forming process is considered to be gleization operating at a reduced intensity in northern areas because of the cold climate and short growing season (Tedrow and Cantlon 1958). Perhaps reduced paludization or littering (Buol *et al.* 1973) should be included as a pedogenic or geogenic process.

Bog (organic) soils, regarded as forming by paludization with little humification, display few differences in morphology from Low Arctic to High Arctic (Tedrow 1968, Tedrow *et al.* 1958).

Gley soils of polar regions receive the most attention by Soviet pedologists who recognize many genetic varieties such as podzolized, illuvial-humic, solonchak, and others as well as cryogenic types including polygonal, spotted, mottled, and hummocky (Kreida 1958, Ignatenko 1965, 1973, Rozov and Ivanova 1967b).

An interesting and consistent feature of most Tundra (gley) soil is the zone of organic matter concentration occurring at or adjacent to the permafrost surface (Tedrow *et al.* 1958, Tedrow 1962, 1965, 1966a, 1973b, Brown 1967). Genesis of this phenomenon is thought to be cryopedogenic

(Tedrow 1965) or the result of some type of mobilization during a period of warmer climate in late Wisconsin time (Tedrow 1966a). Soils with similar features, called illuvial-humic types of tundra and arctic gley soils, appear to be common in Eurasian polar regions (Kreida 1958, Svatkov 1958, Ivanova *et al.* 1961, Ignatenko 1965, 1971, 1973, Liverovskii 1965, Rozov and Ivanova 1967b, 1968). Soviet pedologists generally attribute formation of these organic-rich layers to migration of mobile humic substances to the permafrost table. Examination of data presented by Day (1964) suggests that similar activities may occur in drier soils as well.

Soils of the Hummocky Ground (Tedrow 1970, 1973b), considered as the High Arctic equivalent of the Upland Tundra Soil--a subgroup characterized by Tedrow and Cantlon (1958), Tedrow *et al.* (1958), and Douglas and Tedrow (1960)--are described as gray brown mineral soils with thin organic mats. They occupy slopes and are subject to intense frost action.

Soils of the Polar Desert-Tundra Interjacence (Tedrow 1970, 1973b) occupy low positions, are sparsely vegetated, and lack pedogenic horizons. Supersaturated in early summer, they become much drier over the season. Salt crusts and saline conditions are associated with these soils.

Tedrow's system of classification represents a major advancement in the understanding of polar soil systematics and genetics. Unlike the Soviet system, state of developement relationships (eg. moisture regime) across ecological boundaries (namely Low Arctic versus High Arctic) can be discerned. Once comprehended, the separation concepts relate to various genetic soils of temperate and boreal regions. Unfortunately separation limits of the taxa are not clearly stated or quantified in the literature. This has lead to some misinterpretation and misuse.

Schemes of soil classification designed for temperate regions have

been tried in the Canadian Arctic. McMillan (1960), who did not subscribe to Tedrow's views, employed Kubiena's (1953) classification system at various sites in the Queen Elizabeth Islands. Day (1964) used the Canadian soil classification system (N.S.S.C. 1963) and the 7th Approximation (Soil Survey Staff 1960) to classify sampled profiles at Lake Hazen, Ellesmere Island. Ten of the twelve profiles studied were classed as Subarctic Saline and Orthic Regosols in the Canadian system and Cumulic Cryothents in the American system. Examination of descriptions, analytical data, and plates indicate that these soils appear to span Tedrow's (1973b) freely drained Polar Desert Soils, intermediate drainage situations involving Soils of the Polar Desert-Tundra Interjacence and Soils of the Hummocky Ground, and the more poorly drained Tundra soils with very thin organic mats. This demonstrates the inability of these systems to differentiate soils of different soil-forming environments.

Arctic Soil Classification and Patterned Ground

Recently there has been increasing acceptance of frost processes as being pedogenic as well as geomorphic. Profiles are modified and new microenvironments created by freezing processes.

However, very little is known about the actual mechanics of freezing processes. Washburn (1973) describes the freezing of soil as a complicated thermodynamic process and that heaving or various other frost phenomena occur through various interactions involving amount of water available, effects of temperature and pressure, grain size distributions, and effects of clay mineralogy. Buol *et al.* (1973) use the term "congelipedoturbation" to define mixing in soil by freeze-thaw cycles. Brown (1967) describes ice-wedge growth and relates it to Tundra soil formation.

An almost universal drawback of all systems used to group soils of

the Arctic is their inability to accommodate soils of patterned ground terrain. Of primary concern are the processes of congeliturbation (*sensu* Hopkins and Sigafoos 1951) and gelifluction (*sensu* Flint 1971, Washburn 1973) that disrupt normal horizonation by churning and thrusting of mineral soil material.

Attempts at solving the soil classification-periglacial phenomena problem are many. Drew and Tedrow (1962), Tedrow (1962) and Brown (1966) correlate the genetic soil groups (Tedrow and Cantlon 1958, Tedrow *et al.* 1958) with classifications of patterned ground adapted from Washburn (1956). In the classification of Soviet arctic soils, patterned ground types are often used at the "genetic soil type" level of abstraction (Rozov and Ivanova 1967b, 1968). The studies of Ignatenko (1963, 1966, 1973) provide excellent examples of this useage. Sokolov and Sokolova (1962) differentiate non-cryogenic and cryogenic soils at a high level of generalization (zonal soil group). James (1970) divides soils of the Rankin Inlet area, N.W.T., into " soils relatively undisturbed by frost" and "frost-disrupted soils". Within the latter he differentiates between disturbance on a small scale that is restricted to the immediate vicinity of the periglacial feature (for example, the rims and trenches of "frost-fissure polygons") and disturbance that covers extensive areas (for example, "frost-churned soil" of circles, solifluction, steps, and hummocks). Ugolini (1966a, 1966b) groups soils affected by cryogenic processes as variants of certain Great Soil Groups (according to Tedrow *et al.* 1958). Thus soils with brunisolic-like morphologies but displaying some disruption by frost churning or surficial cracking were classed as Arctic Brown soils (Ugolini 1966a). Tundra variant soils (Ugolini 1966b) include Tundra soils (gleyed mineral soils) of gelifluction slopes, Tundra soils associated with certain pat-

terned ground features, and Tundra soils associated with turf-hummocks.

Polygonal types of patterned ground often tend to present a special problem. Disrupted profiles only occur along rims and trenches of fissures (James 1970). The large relatively unaffected areas of polygon centers may have genetically different soils than occur along fissure rims and trenches because of microtopographic effects (Tedrow and Cantlon 1958, Everett 1974). Also, polygonized ground is associated with all drainage regimes whereas other types of patterned ground tend to occur most frequently under conditions of impeded to moderate drainage (Drew and Tedrow 1962) except with organic soils (Hopkins and Sigafoos 1951).

In a number of studies involving soil classification at lower levels of generalization, soils occupying different portions of a patterned ground "mesh" (*sensu* Washburn 1956) are classified as separate pedons (Brown 1966, Ignatenko 1973). Hypothetically, the non-vegetated, heaved portion of a circle might be classed as "Regosol"; the vegetated, relatively undisturbed portion as "Arctic Brown"; and the transition between the two as "shallow Arctic Brown". The alternative is to class the portions of the mesh (three in the example) as if belonging to a single pedon.

Partial application of the pedon concept has occurred through the establishment of soil series whereby somewhat generalized patterned ground types are associated with certain soil series (Tedrow and Douglas 1964, Tedrow *et al.* 1968, Holowaychuck and Everett 1972). The mapping units defined by Holowaychuk *et al.* (1966) perform the same function. Although utilized in arctic areas relatively unaffected by frost processes, this methodology merits consideration for more intensively altered terrain.

Arctic Soil Classification and Mapping

Until recently there has been little need to delineate the distributions of soils for many arctic areas. Perhaps, however, problems associated with the mapping of polar soils, alluded to by Tedrow and Cantlon (1958), have discouraged soil map construction. Foremost of these problems is, again, the soil classification-patterned ground enigma.

Generalized soil and patterned ground information has been presented on relatively small scale (1:36,000 to 1:107,000) maps (Everett 1968, Tedrow *et al.* 1968, Tedrow 1970, Cruickshank 1971, Holowaychuck and Everett 1972). Detailed maps (1:500 to 1:6,000) depicting detailed soil and patterned ground information have also been used (Everett 1968, Holowaychuk and Everett 1972). The fairly detailed soils plus terrain features (adapted from Washburn 1956) maps done by Brown (1966) and King (1969) approach a "catalogue" rather than survey effect. A similar type of soil survey, involving fairly detailed soil taxa and patterned ground types, was done on the Taimyr Peninsula, USSR (Ignatenko 1973, soil map in Matveyeva *et al.* 1974). Holowaychuk *et al.* (1966) were probably the first pedologists to apply the pedon concept (Soil Survey Staff 1960) to the classification and mapping of arctic soils. Using taxa of Tedrow's system (Tedrow and Cantlon 1958, Tedrow *et al.* 1958) and the 7th Appromimation (Soil Survey Staff 1960) Holowaychuk *et al.* (1966) recognized cyclic pedons created by "frost scars" and the distributions of such pedons within their mapping units. Mapping of soil series taxa (Holowaychuk and Everett 1972) with inherent cyclic pedons (see discussion above) accomplishes a similar effect. Cruickshank (1971) achieves a similar result but at a lower level of abstraction by recognizing groups of patterned ground types within his terrain (map) units. Associations (*sensu* Anon. 1973) of soil subgroups (according

to Soil Survey Staff 1974) were employed by Everett (1974) to map an area of polygonized tundra at Barrow, Alaska.

Other problems pertaining to soil classification and mapping in arctic regions include poor soil-vegetation relationships and slow readjustment of soils to new environments, particularly drainage (Tedrow and Cantlon 1958). Although soil-vegetation relationships are usually prononced on freely drained sites, a spectrum of vegetation communities representing well drained to wet sites can occur on soils formed under conditions of restricted drainage (Tundra and Bog soils; Tedrow and Cantlon 1958). Closely related is the problem of slow readjustment of soil morphologies to coincide with present site conditions. Wet mineral soils lacking significantly thick organic layers and relatively dry organic (Bog) soils with mesic and, on occasion, xeric plant communities illustrate this problem.

The Cryosolic Order

Introduced for use over a two-year trial period is the tentative classification system for northern soils--the Cryosolic Order (C.S.S.C. 1973). Augmenting the existing Canadian system for soil classification, this new Order represents a new yet simple approach to concepts underlying classification of soils developed on permanently frozen materials.

Cryosolic soils are those mineral and organic soils that have perennially frozen material (permafrost) within 1 meter of the surface in some part of the soil body (pedon). The mean annual soil temperature is less than 0° C. These are the dominant soils of the continuous permafrost zone. Pedogenic zonality is inherent since the Cryosolic Order recognizes at the first level of separation the regional climate which, through its influence on other soil-forming factors (biota, drainage, and time) creates a peculiar kind of soil-forming environment. Zonality based on areal domin-

ance is also realized.

Three major kinds of Cryosolic soils are recognized at the secondary level of abstraction (the Great Group level). These are: (1) mineral soils displaying marked cryoturbation and generally occurring on patterned ground (Turbic Cryosols); (2) mineral soils without marked cryoturbation (Static Cryosols); and (3) organic soils (Organo Cryosols). Through adherence to the pedon concept (Soil Survey Staff 1960) and clear boundary condition definitions this system adequately handles most cyclic features produced by congeliturbation (*sensu* Hopkins and Sigafoos 1951) and gelifluction (*sensu* Flint 1971, Washburn 1973). These physical processes, functions of climate, drainage, and parent material, that modify soil profiles are therefore considered pedogenic. Soils of polygonized ground (see preceding discussion) and soils with very subtle morphologies (Pawluk and Brewer 1975) like some Polar Desert soils (Tedrow 1966b) may present some problems when applying this classification system.

C.S.S.C. (1973) nomenclature (eg. Brunisolic, Regosolic, Gleysolic) used at the third level of separation (subgroup and modifier) reflect conventional pedogenic concepts gained from the study of temperate and boreal soils and are assigned to soils on the basis of the features dominating two-thirds of the pedon. Usage of this terminology at higher levels of abstraction is not justifiable because the implied processes are only weakly expressed and in many cases, are overridden by cryogenic processes.

Subgroup separations within the Organo Cryosol Great Group indicate the fibre content of the dominant organic layer and, therefore, the relative degree of humification (Fibric, Mesic, or Humic).

Zoltai and Tarnocai (1974) applied Cryosolic Order taxa to soils of hummocky terrain occurring along the Mackenzie River. They also include

a section listing criteria that define the various taxa.

The author feels that taxa of the Cryosolic Order best handle the variety of soils encountered in the study area. However, certain depth limits for various taxa (especially Organo Cryosols) are considered unrealistic for this High Arctic environment. Accordingly, these are modified as set out in a section to follow.

METHODS AND MATERIALS

Field Survey and Mapping Techniques

Lack of prior experience with arctic terrain and its systematics plus the physical limitation imposed by the lack of any geodetic or grid surveys of the study area caused the field research to progress in a somwhat haphazard manner. Nevertheless, the general objectives were to become familiar with this particular landscape and its components and to develop concepts pertaining to terrain systematics.

Firstly, soils of the two intensive study sites (see Fig. 1 for location), selected by project leaders to represent raised beach and hummocky sedge-moss meadow conditions, were mapped in detail (Peters and Walker 1972). Sampled profiles from these intensive study sites are identified by location (either Intensive Raised Beach or Intensive Meadow) and an alpha-numeric plot number indicating a 5 x 5 m^2 plot within the intensive site.

The remainder of the study area was surveyed, by foot traverse, at a much lower level of intensity. Terrain components and relationships were noted and identified. Soil pits, dug to the frost table or lithic contacts, were examined and profiles briefly described at selected sites.

Black and white air photos with a scale of approximately 1:5,000 were used in the field work for initial stratification of soil boundaries. The final soil map (in back pocket) is produced upon an orthophoto (controlled) mosaic base having a scale of approximately 1:15,000.

During the course of the survey, soils of selected sites, in most cases deemed representative of identified soil-vegetation-drainage conditions, were sampled on a horizon basis. Three profiles in organic materials were sampled in a stratified manner (3 cm increments) and C horizons

of some of the deeper, drier soils in stratified sands and gravels were sampled at 2 or 3 levels. The only sample of frozen material was collected at Site 1 (Fig. 2) with the use of a hand-operated ice auger.

One hundred fifty-four samples from 50 profiles were collected within the study area. Those not associated with intensive study sites are identified by consecutive numbers from 1 to 41 and located as shown on Figure 2. At all sampling sites soil profile morphologies and site characteristics were described using the guidelines of the Canada Soil Survey Committee (C.S.S.C. 1970).

Five line transects were studied at various locations on the Truelove Lowland (Fig. 3) in an attempt to illustrate some of the critical drainage-soil relationships. Along these transects slopes were measured with an Abney level and vegetation and soil changes were identified and noted.

All facets of this study contributed to the formulation of landscape systematics concepts and, ultimately, to the development of a soil map legend. The final phase of the field program involved testing the proposed legend plus ground truthing some of the air photo interpretations. As a result the legend was modified and refined.

Analytical Methods and Materials

Sample preparation involved air drying followed by roller-grinding and collection of soil material passing a 2 mm sieve. Prior to grinding those samples taken by the soil core method were weighed. These air-dry weights were later adjusted to oven-dry weights, using hygroscopic moisture values, for purposes of calculating coarse fragment content (percent by weight of fragments larger than 2 mm relative to total sample weight) and bulk density (gm/cc based on total sample weight).

Figure 2. Approximate locations of sampling sites 1 to 41.

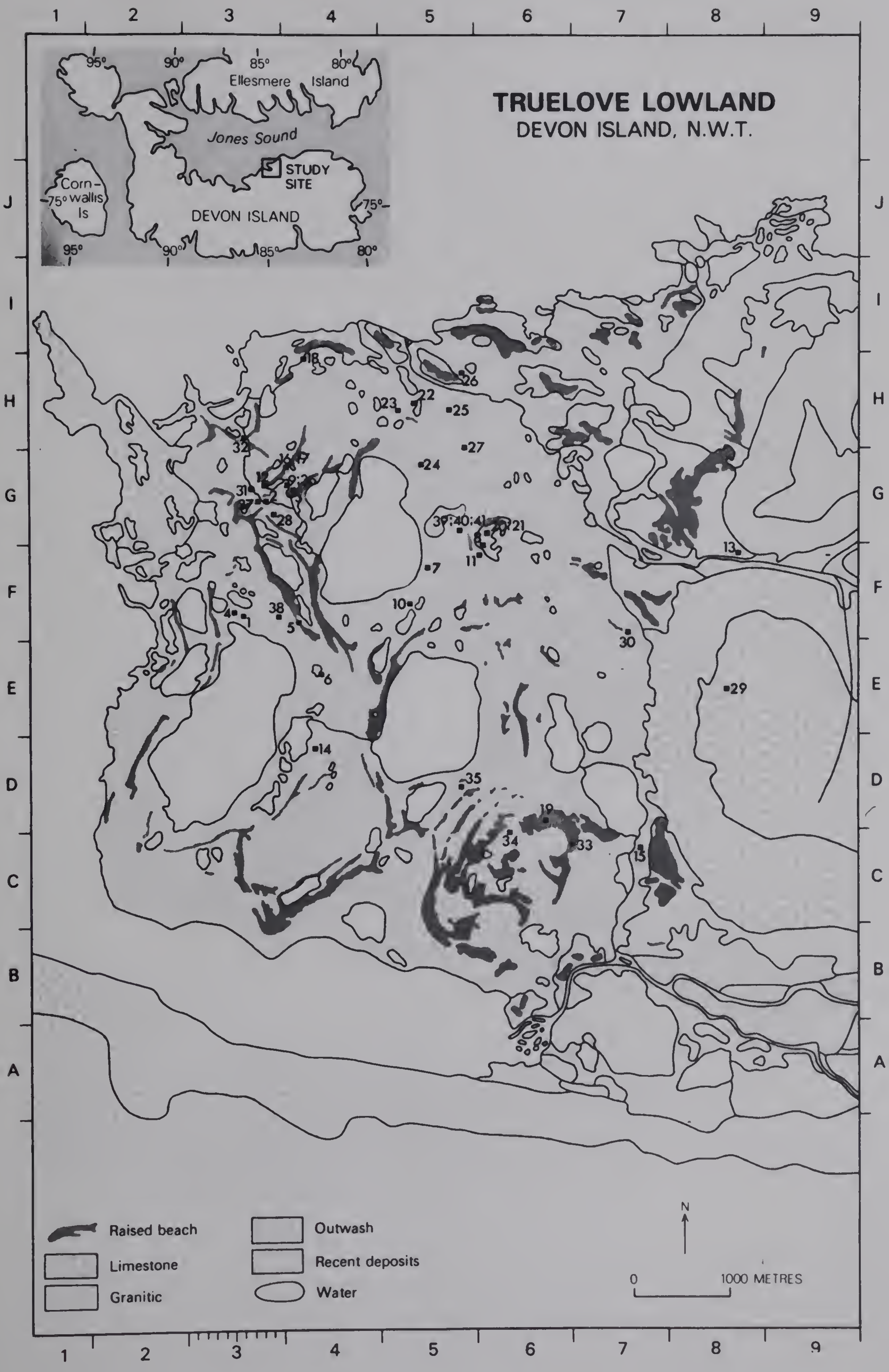
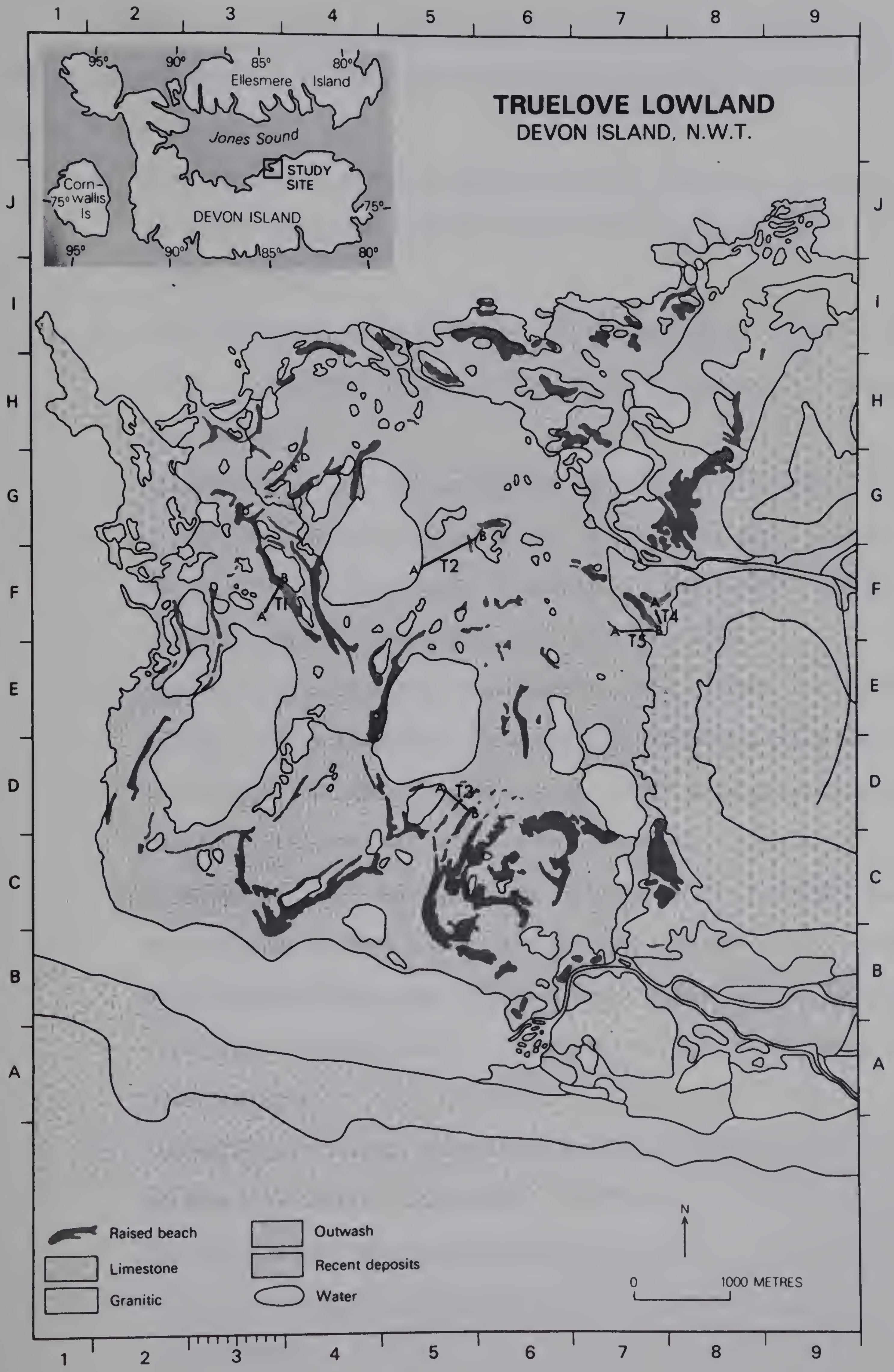

TRUELOVE LOWLAND
DEVON ISLAND, N.W.T.
Ellesmere Island
Jones Sound
STUDY SITE
Cornwallis Is
DEVON ISLAND
95°
90°
85°
80°
75°
Raised beach
Limestone
Granitic
Outwash
Recent deposits
Water
N
0
1000 METRES
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
I
J

Figure 3. Approximate locations of line transects T1 to T5.


TRUELOVE LOWLAND
DEVON ISLAND, N.W.T.
Ellesmere Island
Jones Sound
STUDY SITE
S
DEVON ISLAND
Corn-wallis Is
95°
90°
85°
80°
75°
T1
T2
T3
T4
T5
A
B
1
2
3
4
5
6
7
8
9
A
B
C
D
E
F
G
H
I
J
Raised beach
Limestone
Granitic
Outwash
Recent deposits
Water
N
0
1000 METRES

Chemical and physical analyses were carried out according to the routine procedures used by the Alberta Institute of Pedology. These involved determination of:

1) Soil Reaction; pH was determined with a Beckman model Zeromatic pH meter using the distilled water-saturated soil paste method (Doughty 1941).
2) Total Nitrogen; determined by the macro Kjeldahl method (Prince 1952). A mixture of HgO, $CuSO_4$, and K_2SO_4 (Kel-pak) was used as a catalyst.
3) Calcium Carbonate Equivalent; determined by the manometric method of Bascombe (1961) on samples having pH values (soil paste method) of 7.0 or greater. Inorganic carbon values were calculated using calcium carbonate equivalent data.
4) Organic Carbon; by difference between total carbon and inorganic carbon. Total carbon was determined by dry combustion using an induction furnace (Allison *et al.* 1965) with gasometric detection of evolved CO_2 (Leco model 577-100).
5) Exchange Acidity; determination of exchangeable hydrogen ion by displacement with barium acetate and titration of leachates with standard NaOH (AOAC 1955). Those samples having pH values (soil paste method) greater than 6.5 were not subjected to this analysis.
6) Exchangeable Cations; extraction by displacement with neutral, 1N ammonium acetate (AOAC 1955) and determination of K, Mg, Na, and Ca by atomic absorption spectrophotometry. This analysis was done on samples having pH values (soil paste method) of 7.5 or lower.

7) Exchange Capacity: Following extraction of exchangeable cations, ammonium was displaced with sodium (sodium chloride), collected by distillation into boric acid, and measured by titration with standard H_2SO_4 (Chapman 1965).

8) Oxalate Extractable Iron and Aluminum; by extraction with acid ammonium oxalate (McKeague and Day 1966). Iron was determined by atomic absorption spectroscopy and aluminum colorimetrically using aluminon. This analysis was done on selected samples.

9) Hygroscopic Moisture; or more correctly, the moisture content of air dry soil was determined gravimetrically by the oven drying of subsamples at 105^{o} C.

10) Particle Size Distribution: On samples collected in 1971 (about half of the total taken), particle size distribution was determined by the pipette method of Kilmer and Alexander (1949) as modified by Toogood and Peters (1953). Subsample preparation involved the removal of both organic matter and carbonates. Later consideration of the fact that most of the mineral soils contained primary carbonate particles cast suspicion on the results obtained through the carbonate removal pretreatment method. Consequently, those samples taken in 1972 were subjected to the hydrometer method of particle size analysis (Day 1965) with pretreatment involving removal of organic matter only. A number of samples were analyzed by both methods. Minor, random differences occurred in the results but in no cases were the textural classes altered. Only the sand (2.0 to 0.05 mm), silt (0.05 to 0.002 mm), and clay

(less than 0.002 mm) fractions were separated and measured. Further fractionation (fine clay and sub-sizes of the sand fraction) was not carried out.

The above chemical and physical analyses were conducted using the fine earth fraction (material passing a 2 mm sieve) of the appropriate soil samples and results are reported on an oven dry basis. Hygroscopic moisture values were used to adjust air-dry weights to oven-dry weights in all calculations.

Samples collected in 1971 were analyzed for various available nutrients according to methods used by the Alberta Soil and Feed Testing Laboratory, Edmonton. These analyses included the determination of:

11) Available Nitrogen (N); as nitrate-nitrogen extracted by 0.02N $CuSO_4$ - 0.007N Ag_2SO_4 solution and determined photometrically using pheno-disulfonic acid.

12) Available Phosphorus (P); extracted with a solution of 0.03N NH_4F - 0.03N H_2SO_4 and determined by the HNO_3-vanadate-molybdate colorimetric procedure (Dickman and Bray 1940).

13) Available Potassium (K); extracted with N NH_4OAc solution and determined by flame photometry.

14) Available Sodium (Na); extracted with N NH_4OAc solution and determined by flame photometry. Results were read in ppm.

15) Water Soluble Sulfate (SO_4); extracted with 0.1M $CaCl_2 \cdot 2H_2O$ solution. The extracts are distilled using a reducing agent (a mixture of hydriotic acid, hypophosphorus acid, and formic acid) and nitrogen gas. Evolved H_2S is trapped in N NaOH which is mixed with a bismuth reagent (bismuth nitrate pentahydrate dissolved in acetic acid and mixed with gelatin solu-

tion) prior to the photometric determination of SO_4.

The data from 11 to 14 above were corrected to an oven-dry weight rather than volume basis. To facilitate this calculation, apparent bulk densities (oven-dry basis) of laboratory prepared samples were measured. Water soluble sulfate is expressed on an air-dry weight basis. All data above pertain to the fine earth fractions (particles 2 mm or smaller in diameter) of samples.

Data Replication

The analytical data obtained in conjunction with a study of this nature are not meant to be statistically analyzed since the sampling procedure is, of necessity, biased. However, a limited amount of replication within analyses was included to check the congruity of results obtained in each analysis. This represents a verification on consistency of methodology and apparatus.

For most analyses up to 25% of the samples were duplicated. Results were found to be adequately consistent.

About 65% of the samples subjected to $CaCO_3$ equivalent analysis were duplicated. Occasional gaseous leakage by the manometer apparatus necessitated this action. The highest values of duplicate results are reported.

Initial runs through the exchangeable cation (Ca, Mg, Na, and K) and exchange capacity analyses produced what appeared to be some dubious results. Through the repetition of these analyses 63% of the samples were duplicated and 29% triplicated. Results proved to be adequately accordant in most cases.

PHYSIOGRAPHY AND ENVIRONMENT

General Description of the Study Area

The following general description of CCIBP's study area, encompassing the Truelove Lowland and vicinity, Devon Island, N.W.T., is a summary of the descriptions given by Bliss (1971, 1975b) and Barrett and Teeri (1973).

Devon Island forms the southeast corner of the Queen Elizabeth Islands and is the second largest (54,040 km^2) in this group. Truelove Lowland is the third largest of a series of five coastal lowlands occupying the northeast coast of Devon Island. A small portion of the plateau or upland to the east is included in the study area.

Truelove Lowland (43 km^2) is described as gently sloping, post-Pleistocene strand flat bounded on the west and north by 24 km of shoreline and on the east and south by cliffs which rise some 300 m to a plateau (on upland) that typifies the main body of Devon Island. Peripheral to the study area is the large Devon Icecap which covers the eastern third of the island and rises above the barren plateau (400-500 m) to a maximum elevation of 2,080 m.

Three large lakes, ten medium size lakes, many small lakes and ponds, and two rivers comprise 22% of Truelove Lowland. The Truelove River (refer to the general map, Fig. 1), originating at the Devon Icecap some 10 to 20 km inland, flows through the Truelove Valley and empties into the Truelove Inlet lying along the southern boundary of the Lowland. A smaller river, the Gully river, originates on the plateau and flows north across the Lowland from a mid-point along the eastern escarpment. Several small streams drain the larger lakes.

The remainder of the Lowland landscape consists of sedge-moss dominated meadows (41%), gravelly raised beaches with cushion plant-lichen and-moss communities (20%), rock outcrops with dwarf shrub heath and grass communities (12%), and rockland and coastal salt marsh with lichen barrens (5%).

Base Camp, established in 1960 and presently operated by the Arctic Institute of North America, is centrally located on a large raised beach at the west side of Immerk Lake.

Bedrock Geology

Krupicka (1973, 1976) provides information on the bedrock geology of the Truelove Lowland and adjoining upland areas.

The study area is geologically unique but complex because it occurs at the boundary between crystalline basement rocks of the Canadian Shield and overlying sediments of the Arctic Platform.

All rocks forming the basement complex are crystalline and, with few exceptions, metamorphic. The main rock types are granulites and gneisses, considered to be Archean to Lower Proterozoic in age. The contact between the crystalline basement rocks and the overlying, unmetamorphosed, Arctic Platform sediments is conspicuous on the eastern escarpment (Plate 2) and dips gently to the southwest.

The platform sediments occurring in the study area are primarily composed of silty dolomite. Two, thin, partly dolomitic, sandstone layers occur in the dolomite sequence; one at the base and a second some 200 m higher. Three marker horizons of massive dolomite of reef origin can be found in the dolomite cover of the escarpment. The lowermost of these also underlies the Rocky Point peninsula and extends a short distance south onto the Lowland. Its age is estimated to be Cambrian.

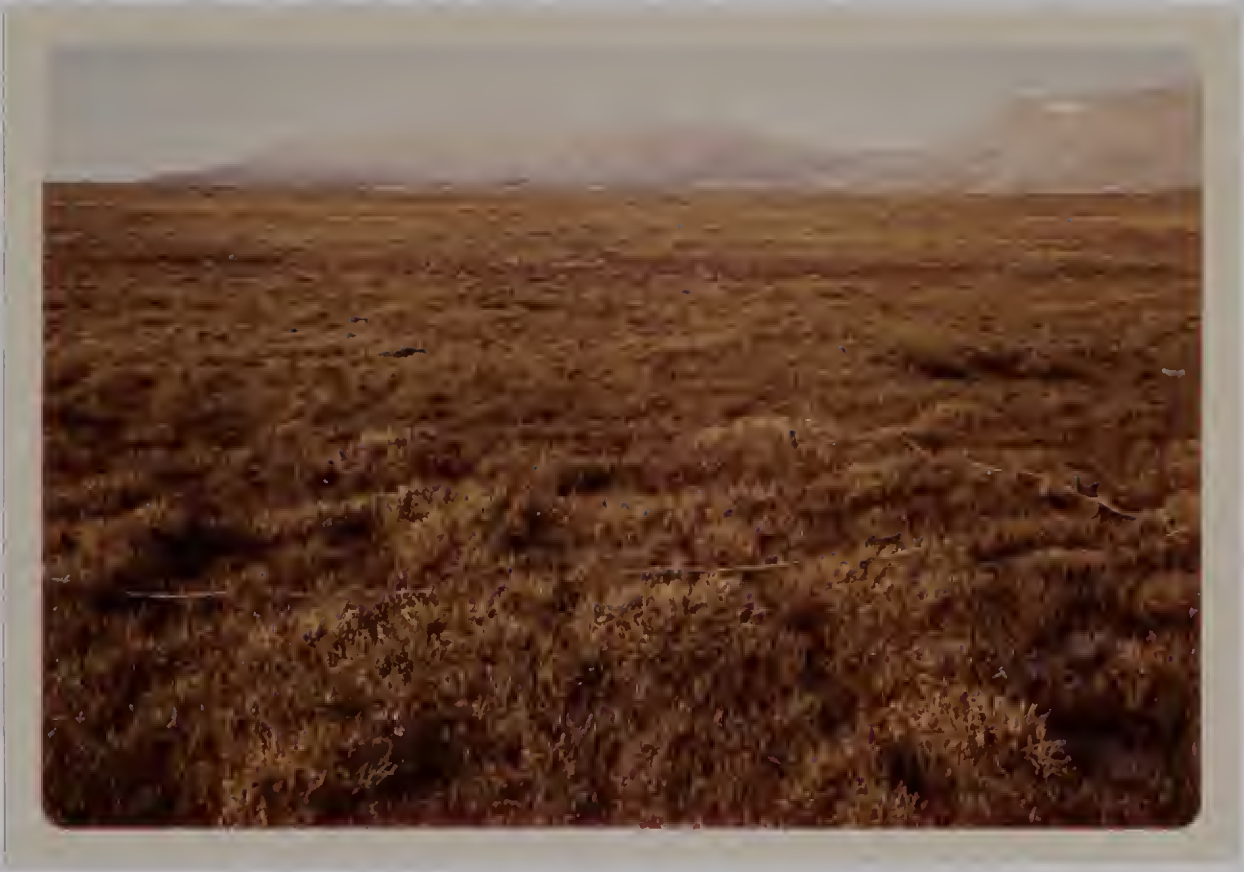


Plate 2. The contact between dark-colored, crystalline basement rocks and overlying light-colored dolomites is evident on the eastern escarpment (background). Fore - and middle ground is dominated by hummocky sedge-moss meadow. View to the NE.

Another unique feature is a conspicuous normal fault that forms the southern boundary of the Truelove Inlet and River Valley. Along the fault plane the northern block subsided about 300 m. The near vertical cliff of the southern block displays primarily crystalline rocks upon which lies a thin, discontinuous capping of platform sediments. The escarpment bordering the Lowland on the east and occurring on the subsided northern block has some 150 to 200 m of dolomitic sediments overlying the basement complex. These differences are evident in Plate 1.

Soil Parent Materials

The identification and separation of surfical deposits occuring within an area is of paramount significance to soil classification at low levels of abstraction. Adequate characterization of landforms or surfical deposits existing within the study area was not previously attempted nor was it included in the IBP study program. Consequently, the following geomorphological information is derived from the author's interpretations of observations and data collected primarily for soil survey objectives. Thus much of this information is drawn from active layer depths only and represents, more correctly, a discussion of parent materials rather than surficial deposits.

The origin of the Truelove Lowland is not exactly known but King (1969) suggested that it is a marine peneplain and was formed by the erosive action of ice and waves. It must be conceded that the present landscape has had a polygenetic history.

Barr (1971) indicates that deglaciation occurred about 9,450 years ago and discusses isostatic uplift in the area; a phenomenon revealed through a series of topographically parallel strandlines rising inland from the present-day shoreline to the base of the eastern escarpment

Using radio carbon dating techniques he dated the marine limit (76 m ASL) and several other raised beaches ranging in ages from 9450 to 3300 years BP. Based on this information and elevations, Svoboda (1972) reconstructed with isochrones the successive areas of emergence. Approximate ages and elevations for sampled profiles presented in this paper are extrapolations from Svoboda's information.

King (1969) suggests that glacial till, derived primarily from the Paleozoic sediments, was subsequently reworked to form the present-day landscape of raised strandlines separated by relatively broad depressions. That glacial till did or still does mantle much of the Lowland is exceedingly difficult to ascertain. Nevertheless, the ubiquitous occurrence of boulders of variable lithology suggest that ice, whether marine or glacial, had an influence in the deposition or modification of Quaternary deposits.

Table 2 presents a very general characterization and description of mineral parent materials (or surface materials) and landforms occurring in the study area. Figure 4 depicts the distributions of most of these materials.

Most of the unconsolidated deposits are derived, in the main, from the Arctic Platform sediments (dolomites), therefore being calcareous and alkaline. However, elements of the crystalline basement complex (granulites and granitic gneisses) also occur, amounts depending on proximity to basement outcrops.

Materials labelled as "alluvial-lacustrine" (As) are peculiar with respect to source rocks and mode of origin. Relatively fine textures suggest water deposition. Medium acid to mildly alkaline reactions and very low carbonate contents cast doubt upon the dolomitic upland and escarpment as source areas. Probably they were deposited in a seawater or fresh

Table 2. General characteristics of mineral parent materials and exposed rock in the study area.

ID. SYM.	PARENT MATERIAL	TEXTURE	REACTION	CALCAREOUS CLASS	DOM. LITH. SOURCE	COARSE FRAGMENT DESCRIPTION	LANDFORM	DISTRIBUTION
Aa	Alluvial-lacustrine material	Variable: medium to fine textured	medium acid to neutral	weakly to non-calcareous	Probably dolomite	Very few to none	Alluvial-lacustrine plain	Aa on Fig. 1
Av 1	Alluvial material	Medium to moderately fine textured	mildly alkaline	extremely calcareous	dolomite	Content increasing with depth; variable sizes and shapes.	Localized floodplains on other landforms	Most common near Gully River.
Av 2	Alluvial material	fragmental			dolomite	Rockland; angular and thin, flat gravels to boulders	Alluvial cone	Base of eastern escarpment; coordinates E 7 & D 7, Fig. 1.
Bd 1	Beach material	coarse-skeletal	moderately alkaline	moderately to strongly calcareous	dolomite	Randomly stratified, rounded & subrounded sands, gravels, and cobbles; excessively stony areas common.	Raised beach	Shaded areas & Bd on Fig. 1.
Bd 2	Beach material	coarse-skeletal	neutral to mildly alkaline	weakly to non-calcareous	crystalline rock	50-90%; rounded & subrounded gravels to stones; some stratification.	Veneer over crystalline bedrock	Numerous crystalline rock outcrops in area.
Bd 3	Beach material	fragmental	*moderately alkaline	*extremely calcareous	dolomite	Rockland of angular gravels; sometimes overlying coarse-skeletal sands & gravels*	Raised beach	Raised beaches on and near Rocky Point.
Bd 4	Beach material	fragmental			variable	Rockland; angular & subrounded gravels, cobbles, and stones.	Present beach and tideland	West and south coastline.
Cv	Colluvium	fragmental			dolomite	Rockland; angular to thin, flat stones and boulders. Small areas with thin, flat gravels.	Escarpment (includes Gully floor).	Cv on Fig. 1.
Ow 1	Outwash	fragmental			variable	Rockland; rounded, subrounded, and angular gravels to stones.	Active stream channel	River and stream beds.
Ow 2	Outwash	coarse-skeletal			dolomite	50-90%; rounded and sub-rounded gravels and cobbles.	Rolling outwash plain	Ow on Fig. 1.
Rc 1	Crystalline rock -consolidated	(consolidated)					Crystalline rock outcrop	Rc and tone code on Fig. 1.
Rc 2	Crystalline rock -unconsolidated	coarse-skeletal	neutral to mildly alkaline	weakly to non-calcareous	crystalline	50-90%; angular gravels to stones.	Part of crystalline rock outcrop.	<40% of crystalline rock.
Rl	Limestone rock	(consolidated)					Limestone plain	Rl on Fig. 1.
Tg	Till	medium to moderately fine textured	mildly alkaline	extremely calcareous	dolomite	<20% angular gravels; occ. small islands of rockland.	Ground moraine	Plateau, Tg on Fig. 1.
Tm	Till	moderately coarse to coarse-skeletal	moderately alkaline	very strongly calcareous	dolomite	20-90%; subrounded gravels to stones; both dolomite and crystalline stones common.	Lateral and end moraine	Tm on Fig. 1.
Un	Undifferentiated	moderately coarse textured	mildly to moderately alkaline	strongly to very strongly calcareous	dolomite	<20% rounded to subrounded gravels to cobbles; excessively stony areas common.	Undifferentiated plain.	Un on Fig. 1.

* Reaction and calcareous classes are of underlying coarse-skeletal sands and gravels.

Figure 4. General distribution of mineral parent materials in the study area. Legend:

As - Alluvial-lacustrine

Bd - Beach deposits (also dark shading showing raised beaches)

Cv - Colluvium

Ow - Outwash

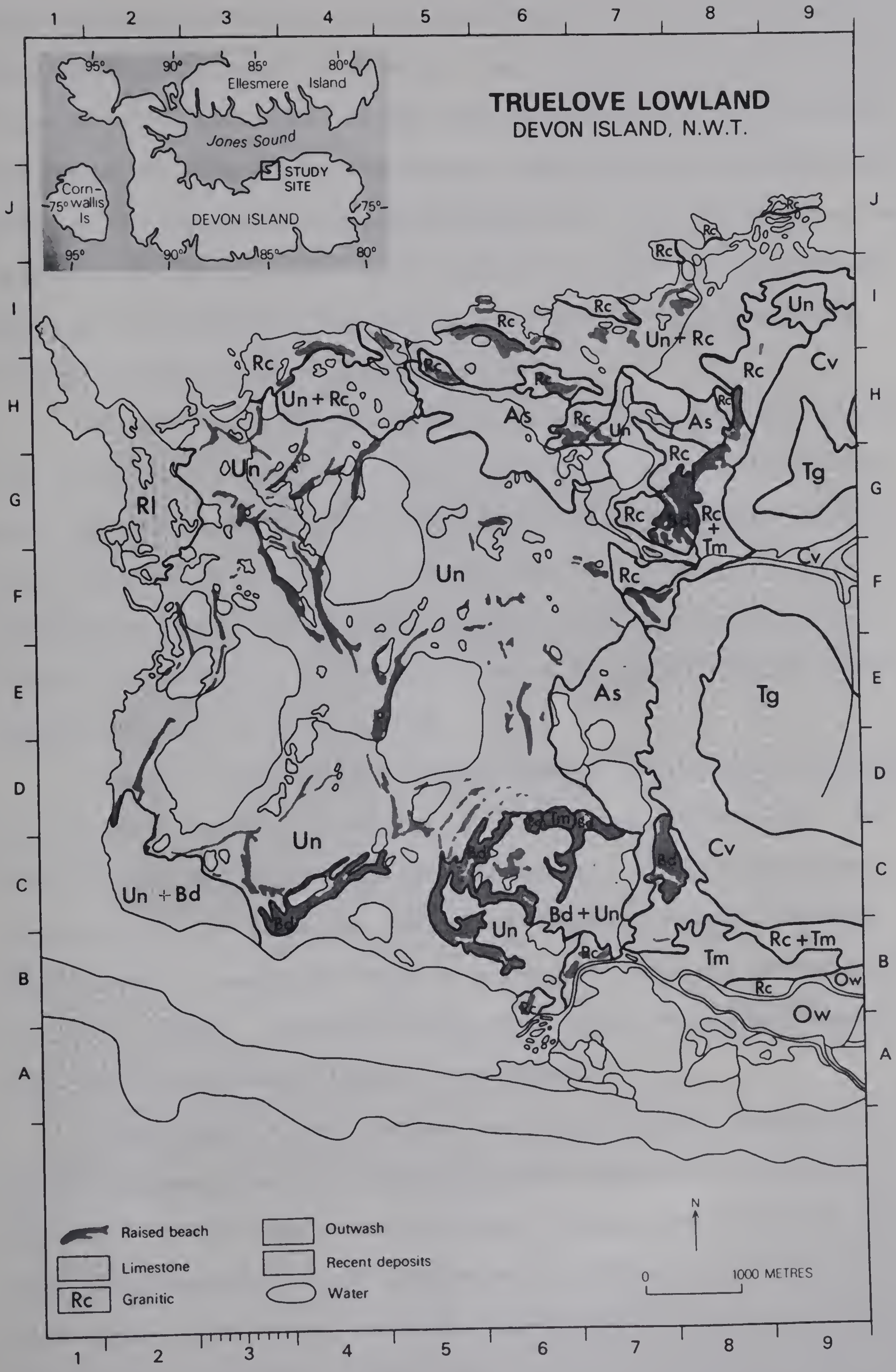
Rc - Crystalline bedrock (also shading pattern designating granitic areas)

Rl - Dolomite bedrock

Tg - Glacial till of the Upland

Tm - Glacial till of the Lowland

Un - Undifferentiated materials


TRUELOVE LOWLAND
DEVON ISLAND, N.W.T.
Ellesmere Island
Jones Sound
STUDY SITE
DEVON ISLAND
Cornwallis Is
95°
90°
85°
80°
75°
Rc
Un + Rc
Un
Rl
As
Tg
Cv
Rc + Tm
Bd
Tm
Un + Bd
Bd + Un
Tm
Ow
Raised beach
Limestone
Granitic
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water lagoon situation that involved blocking of drainage exits through the crystalline outcrops to the north. Low exchangeable Na values obtained for associated soils suggest either fresh water deposition or a leaching environment following marine deposition. Repetition of the lagoonal situation, as is suggested by "cumulized" (Buol *et al.* 1973) horizons, may have caused Ca, Mg and/or Na salts to be washed out through repeated drainage. Choice of the identifying term "alluvial-lacustrine" was influenced by textural characteristics of these materials.

In addition to the mineral materials two types of organic deposits were identified. Localized, shallow basin areas of the undifferentiated plain (Un, Fig.4) exhibit sufficiently thick deposits of organic material that no mineral layers are encountered within the active layer. From an ecological standpoint, such organic deposits, regardless of their total depths of accumulation, must be considered as the parent materials of the organic soils which develop in them.

The most common of these organic deposits has developed essentially *in situ* and is derived, in the main, from sedges and *Hypnum* mosses. Reaction of this peat is normally slightly acid to neutral, however more acid pH values show up in some stream-side microenvironments. Unrubbed fiber content is roughly 50% based on a few tests using the syringe method of C.S.S.C. (1974). Lenses and discontinous layers of inwashed, fluvial sands can be occasionally found in this deposit.

Small fields of high-centred, ice-cored polygons, consisting of dry surface peat and ground ice mixed with organic materials, are located at what may be critical (to their development) places along streams or among lakes. Characteristic of the landform are the convex to flat-topped, ice-cored mounds, often 1.5 to 5 m across, raised some 0.5 to 1.5 m above narrow (1 m), steep-sided trenches which connect to form the polygonal

pattern. The trenches are underlain by ice wedges that are frequently exposed in places.

Most of the dry peat mantling these mounds is not unlike the wet peat described above. However, in some polygon fields there occurs an underlying, secondary organic deposit which resembles coprogenous or diatomaceous earth (C.S.S.C. 1970) but contains a considerable amount of algal cells and cell fragments. A similar, but more raw, material was observed along the shores of a number of lakes and ponds in the study area. This appears to be slightly decomposed bluegreen algae.

Periglacial Modification of Surficial Materials

Periglacial features are widespread in the study area. Frost processes include congelifraction or frost shattering of rocks and exposed bedrock; congelifluction, manifest by minor gelifluction lobes and slopes; congeliturbation, revealed by the presence of circles, nets, and stripes; and ice-wedge fissure formation. The periglacial features, identified using the unified classification of Washburn (1956, 1973), are commonly associated with certain surficial deposits as tabulated in Table 3.

Ice-wedge fisures and polygons occur in all moisture regimes whereas congeliturbation and gelifluction are generally confined to intermediate to poorly drained situations. Factors that operate to form congeliturbated patterned ground in some poorly drained areas but not in others are largely unknown. It is suggested that a summer season fluctuation in moisture status produces, in combination with the appropriate edaphic conditions, frost-boils (circles, nets, and stripes).

Table 3: Periglacial features commonly associated with the various surficial deposits of the study area.

Deposit	Commonly Associated Periglacial Features
Alluvial-lacustrine	Occasional ice-wedge fissures
Alluvial	None
Beach (All)	Dry--ice-wedge fissures, widely spaced and, therefore, generally not forming a polygonal pattern.
Beach (Bd 1)	Imperfectly drained--circles and nets on level ground, stripes on slopes.
Colluvium	Ocasional "earth debris islands" (Barrett, 1972).
Outwash (Ow 1)	None
Outwash (Ow 2)	Occassional ice-wedge fissures.
Rock (Rc)	Frost shattering and occasional ice-wedge fissures.
Rock (R1)	Frost shattering.
Till (Tg)	Whole morainal plain (plateau) modified by sorted stripes and mass movement (gelifluciton) in the direction of lateral ground-water flow; most rubbly areas exhibit rock circles.
Till (Tm)	Much of this deposit modified by nets and stripes.
Undifferentiated	Much of the undifferentiated plain modified by circles and nets on level ground, stripes on slopes.
Organic (wet)	Occasional ice-wedge fissures.
Organic (dry)	High-centered, ice-cored, ice-wedge polygons.

Climate

Barry and Hare (1974), Bliss (1975b), and Courtin and Labine (1976) provide considerable information concerning macro-, meso-, and microclimates affecting the Truelove Lowland, adjacent plateau, and their landscape components.

Macroclimate affecting the study area, somewhat atypical compared with most of the Canadian Arctic Archipelago, belongs to the eastern High Arctic fringe area that is mountainous and lies near to ice-free seawater

(Baffin Bay). As a result, the area experiences more frequent cyclonic storms particularly in winter (Barry and Hare 1974). Nevertheless, the climate is described as cold desert owing to the infrequency of cyclonic storms, shallow pressure gradients in summer, and low annual precipitation compared with temperate and boreal regions. Being coastal, moderation of climate by seawater, even through thick ice, takes place (Rae 1951, Courtin and Labine 1976).

Geographically, the study area belongs to the High Arctic or Polar Desert Soil Zone. Yet the Lowland sector displays affinity with the Low Arctic or Tundra Soil Zone as reflected by a lush and diverse vegetative cover and a greater degree of soil development compared with the plateau. This and similar "thermal oases" (Courtin and Labine 1976) comprise about 2% of the High Arctic land area (Bliss 1975b) and are explained climatically by Courtin and Labine (1976). Adiabatic dry heating of descending, NE to W air flow causes dissipation of cloud decks and allows greater energy input to the Lowland. In addition, greater snowfall (compared to areas such as Resolute Bay), resulting from increased cyclonic activity and proximity to the ice-free North Water (Baffin Bay) area, promotes lower energy loses from the Lowland during polar dark periods.

Based on 1972-73 data from the Lowland, mean weekly net radiation became positive at the end of May and negative near the end of September. Over the year net radiation balance was positive (17Kly) and comparable to Low Arctic areas (Hare and Ritchie 1973) such as Barrow, Alaska (Weller and Cubley 1972). Global radiation was zero (polar night) for November through February and part of March. About 50% of global radiation occurred before the Lowland was snow-free.

Daily temperatures (at 1.5m) for July and August over the recording

period (1970-73) averaged 3 to 5°C. Occasional warmer temperatures (10 to 15 °C) were associated with föhn winds. The mean temperature for 1972-73 was -17.6°C.

Mean annual precipitation, based on 1972-73 data, was about 280 mm, approximately half occurring as snow. Summer rains usually occurred as light drizzle for short time periods. Snow depths ranged from 10 to 20 cm on wind exposed raised beach crests, 20 to 40 cm in flatter areas, and 50 to 150 cm in raised beach-meadow transition areas and rock outcrops. Snowmelt on the Lowland occurred at the end of June to early July. The Truelove Valley and base of the eastern escarpment were the first to warm in spring. Wolf Hill and rock outcrops also warmed early and, along with most raised beaches, were "hot spots" in summer compared to meadow areas. Coastal fringe areas were the last to warm and generally remained cooler throughout the summer. By late August near isothermal conditions existed across the Lowland. Ice-free seasons of large lakes (ranging from 6 weeks in 1971 to only 50% thaw in 1972 for Immerk Lake) are good indicators of macro- and mesoclimate from summer to summer. Based on snowmelt to 50% leaf coloration, growing season length for 1970 and 1971 was 45 days for the intensive meadow site and 51 days for the intensive raised beach site (Bliss 1975b).

Ground temperatures and active layer thaw depths and rates, measured over a one year period (Brown 1976), showed patterns similar to the warming trends described above. Thaw began in mid-to late June but by mid-September the entire active layer had refrozen. This places the period of maximum thaw at mid-to late August. Thaw depths also indicate climate from summer to summer, being deepest in 1971 and shallowest in 1972. Among raised beach, polygon, and meadow sites, the meadow site had the

warmest mean annual ground temperatures (Brown 1976).

Mean monthly relative humidity (recorded during the summers of 1970-73) was consistantly high, seldom sinking below 80%.

Wind speeds (at 10 m) averaged 2-3 ms^{-1} in June through August and 1 to 2 ms^{-1} in winter. Higher speeds (25 to 35 ms^{-1}) occurred during occasional, short periods of cyclonic storms and föhn winds. Depending upon their time of occurrence föhn winds had significant environmental influence such as causing nearly complete snowmelt within a 48-hour period (late June 1970).

Based on summer season data, the plateau had cooler mean temperatures (1-1.5°C), higher mean wind speeds (0.1-1.0 ms^{-1}) and slightly greater precipitation (2-9 mm) than corresponding periods on the Lowland. Generally, snowmelt occurred 2 weeks later and refreeze 1 week earlier on the plateau. Greater temperature amplitudes, indicating a more continental climate, were experienced on the plateau. Thus the upland (or plateau) portion of the study area displayed a harsher climate, shorter growing season, and very cold soils (thawed by excess solar radiation).

Raised beaches and meadows differ markedly with respect to temperature and moisture regimes. Five-day mean temperatures at three depths over 15 months spanning 1972-73 are shown in Figures 5 and 6 for the raised beach site (Regosolic Static Cryosol) and the meadow site (Fibric Organo Cryosol), respectively. These data illustrate site differences in temperature amplitudes over a year, lag times with increasing depth, temperature gradient reversal times, refreezing trends, and active layer thicknesses. The second small peak in mid-September for the saturated meadow site (Fig. 6) is thought to be caused by heat release during phase change (water to ice).

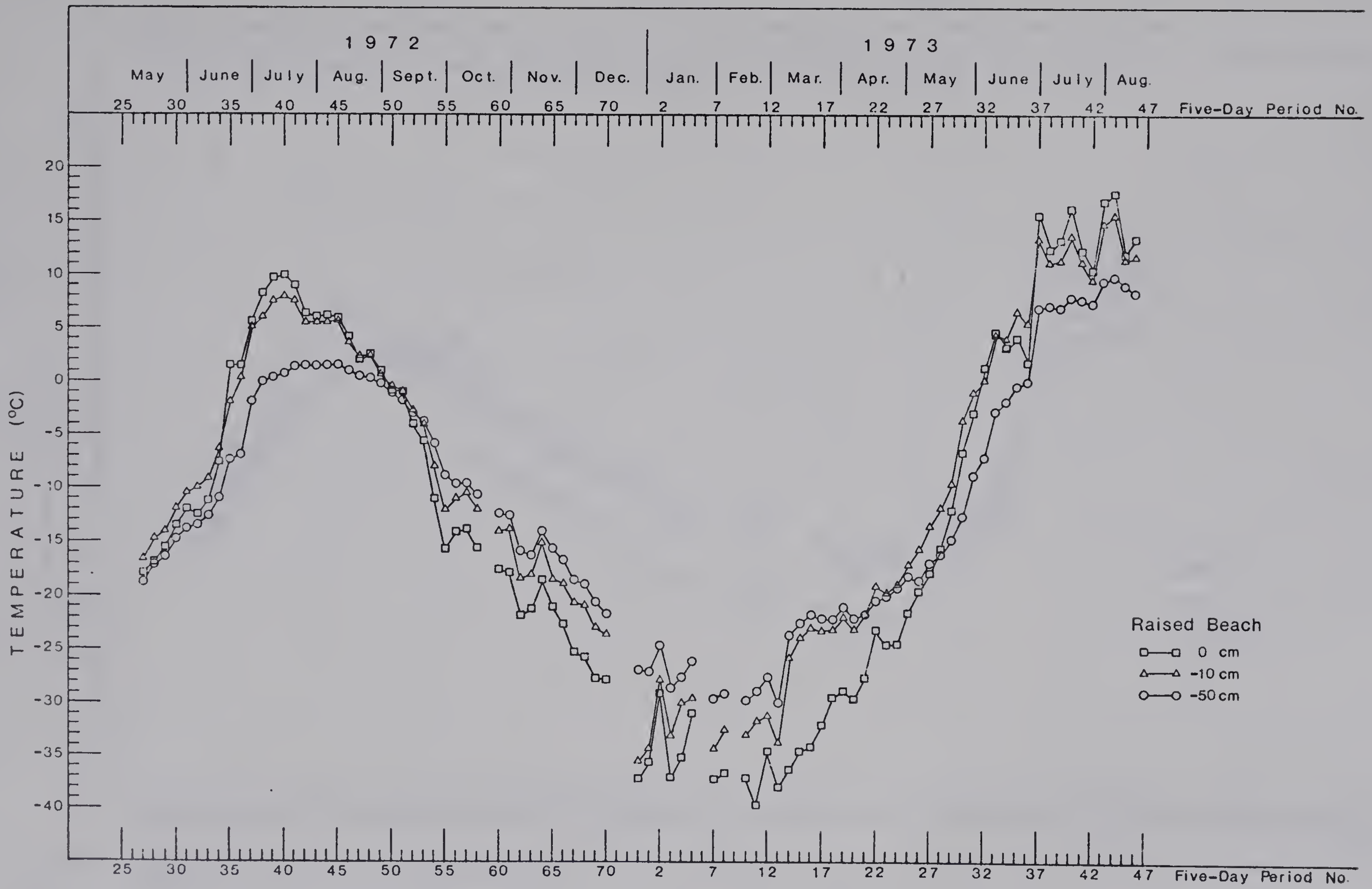


Figure 5. Five-day mean temperatures at three depths for the intensive raised beach study site (crest zone) having a Regosolic Static Cryosol developed in gravelly beach (Bd 1) material. (Data courtesy of G.M. Courtin 1974, pers. comm.)

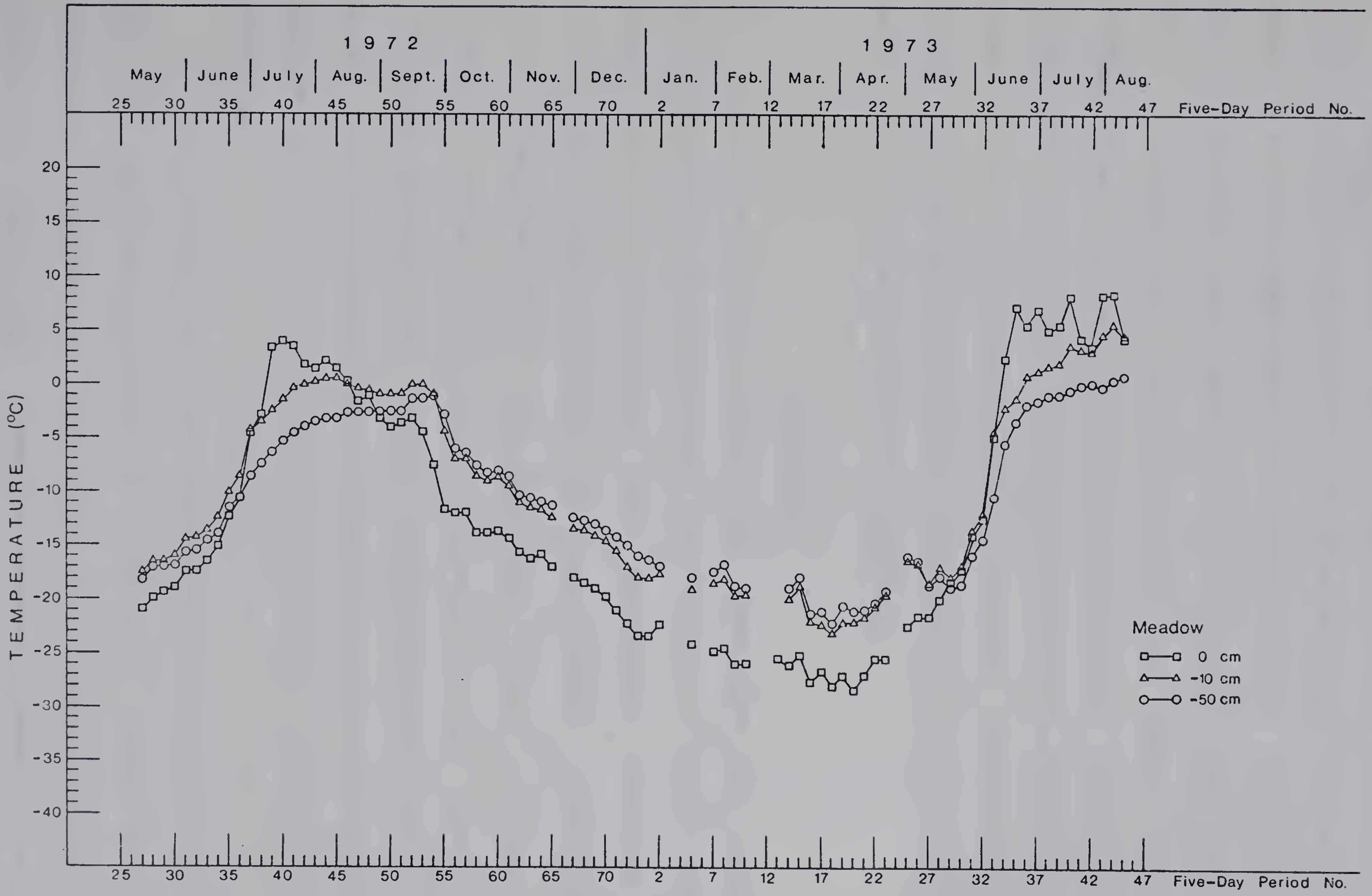


Figure 6. Five-day mean temperatures at 3 depths for the intensive meadow study site having a Fibric Organo Cryosol developed in wet organic material. (Data courtesy of G.M Courtin 1974, pers. comm.)

Organic soils of meadows are always at or near saturation below about 3 to 5 cm. Water potential of upper soil layers was measured at above -2 bars generally (Bliss 1975b, Addison 1976). Water potentials in dry, deep (*cf.* active layers) raised beach soils ranged from -10 to -30 bars. Evaporation from the Lowland is much lower than for temperate regions owing to low temperatures and high humidity. Meadows, often having free surface water, lose more water through evaporation than the warmer raised beaches (Addison 1976). The coarse textured beach materials permit rapid and deep penetration of precipitation and meltwater thereby making much of it unavailable for evaporation.

Vegetation

Vegetation patterns, habitats, and communities, plant species, and site productivity of the study area are presented by Barrett (1972), Barrett and Teeri (1973), Bliss (1975b), Bliss *et al.* (1976), Muc (1976), Muc and Bliss (1976), Richardson and Finegan (1976), Svoboda (1976), and Vitt and Pakarinen (1976). Most pertinent to this study on soil distribution is the characterization and delineation of plant communities (Bliss 1975b, Muc and Bliss 1976). Table 4 presents significant plant communities of the study area arranged along the moisture gradient and indicates their relative distributions (percentage of the Lowland) and general landscape positions.

Within cushion plant-lichen communities vascular plants provide about 20% cover and lichens and mosses 40 to 45% cover. Commonly occurring vascular plants include *Dryas integrifolia, Saxifraga oppositifolia, Carex nardina,* and *Salix arctica.* Among the numerous lichens *Alectoria pubescens* is abundant. Plate 3 shows a raised beach dominated by this community.

Table 4. Plant communities of the Truelove Lowland and adjoining upland arranged according to approximate position along the moisture gradient. (Information extracted from Bliss 1975b, Muc and Bliss 1976.)

MOISTURE GRADIENT	PLANT COMMUNITY NAME	% OF LOW-LAND	POSITION IN LANDSCAPE (Refer to Table 2 and Fig. 4)
DRY	Cushion plant-lichen	6.8	Raised beaches (crest, upper slope); comparable sites in rock outcrops; limestone pavement
	Ice-wedge polygon	<0.5	Raised centers of ice-wedge polygons
	Dwarf shrub heath-moss	1.9*	Localized warm habitats of rock outcrops
	Cushion plant-moss	6.9	Lower slopes of raised beaches (transition to meadows)
	Cushion plant-moss with frost-boils	6.4*	Beach and till materials with patterned ground
	Moss-herb (Polar Desert)		Plateau east of the Lowland
	Frost-boil sedge-moss meadow	18.4	Undifferentiated materials with patterned ground
	Hummocky sedge-moss meadow	20.5	Areas of undifferentiated, alluvial-lacustrine, and organic deposits
WET (Saturated)	Wet sedge-moss meadow	2.1	Areas of organic and undifferentiated deposits

* Calculations made by author and based on various data in Bliss (1975b), Much and Bliss (1976).

In cushion plant-moss communities, considered transitional to meadow types, vascular plants account for 58%, mosses 29%, and lichens 13% cover. *Dryas integrifolia, Carex rupestris, Saxifraga oppositifolia,* and, in some places, *Cassiope tetragona* are the predominating vascular species. Important bryophytes are *Tortella arctica, Oncophorus wahlenbergii,* and *Rhacomitrium sudeticum.* Micro-earth hummocks, 10 to 15 cm across and elevated some 5 to 10 cm, are frequently associated with this community (Plate 4). Cushion plant-moss communities with frost-boils are essentially similar but have reduced plant cover because of sporadically vegetated frost-boils (circles, nets, or stripes) that account for 40% or less of their surface area.

The ice-wedge polygon community is very broad conceptually and spans minor occurrences of meadow types with *Carex stans* and *C. membranaceae* to cushion plant-moss types (Plate 5) with *Dryas integrifolia, Salix arctica* and *Alopecurus alpinus.* Generally, however, polygon raised centers are quite dry and commonly have *Dryas integrifolia, Salix arctica,* and numerous lichens.

Localized, environmentally favorable habitats with dwarf shrub heath-moss community occupy 15 to 40% of crystalline rock outcrops (Plate 6). This community is very diverse floristically and ecologically but usually exhibits nearly closed cover of vegetation. Prominent vascular plants include *Cassiope tetragona, Salix arctica, Dryas integrifolia, Saxifraga oppositifolia,* and *Carex misandra. Rhacomitrium lanuginosum, Ditrichum flexicaule, Hylocomium splendens,* and *Polytrichum juniperinum* are some important bryophytes. The most common lichens are *Cetraria nivalis, Thamnolia vermicularis,* and *Dactylina arctica.*

The moss-herb (Polar Desert) community of the plateau is marginally

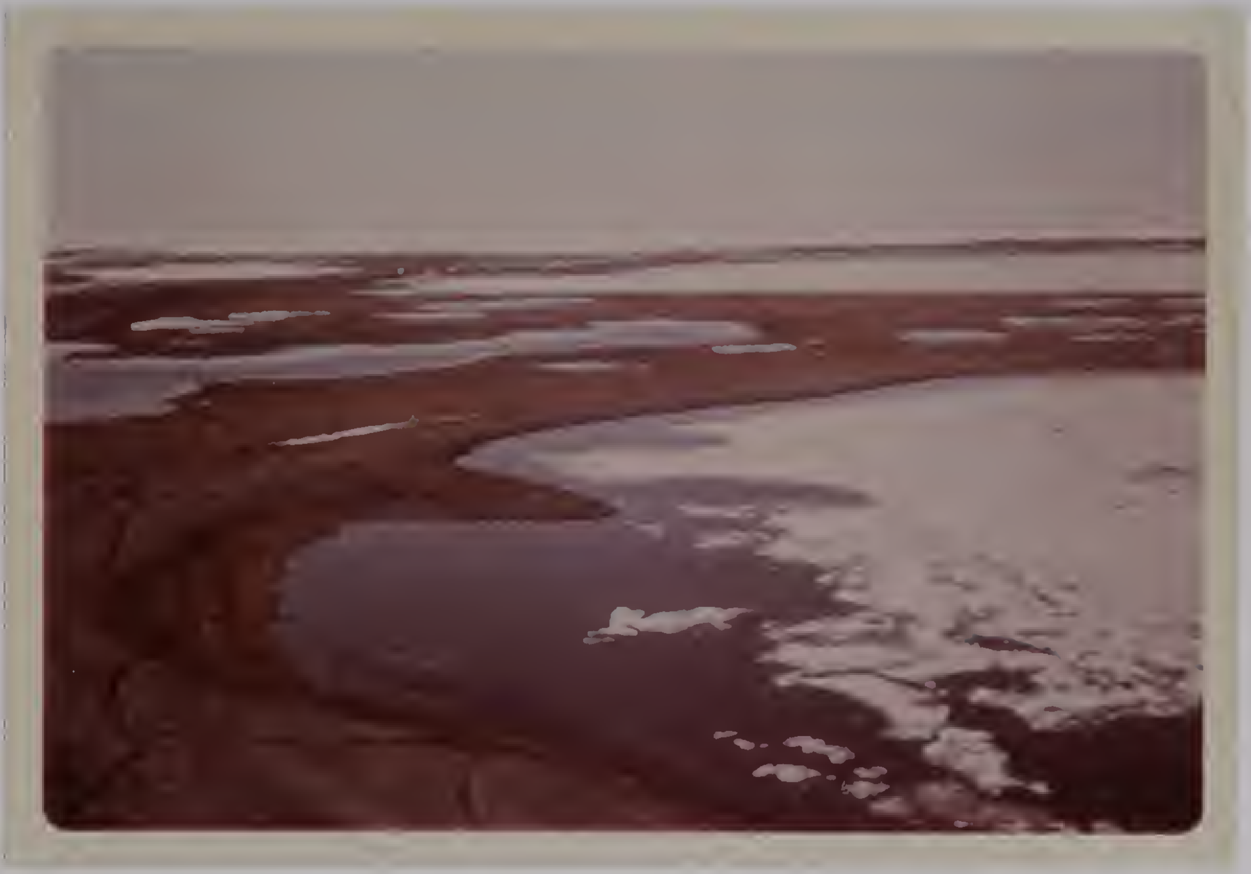


Plate 3. A prominent raised beach dominated by the cushion plant-lichen community (left foreground and curving into central middleground). View to the NW.

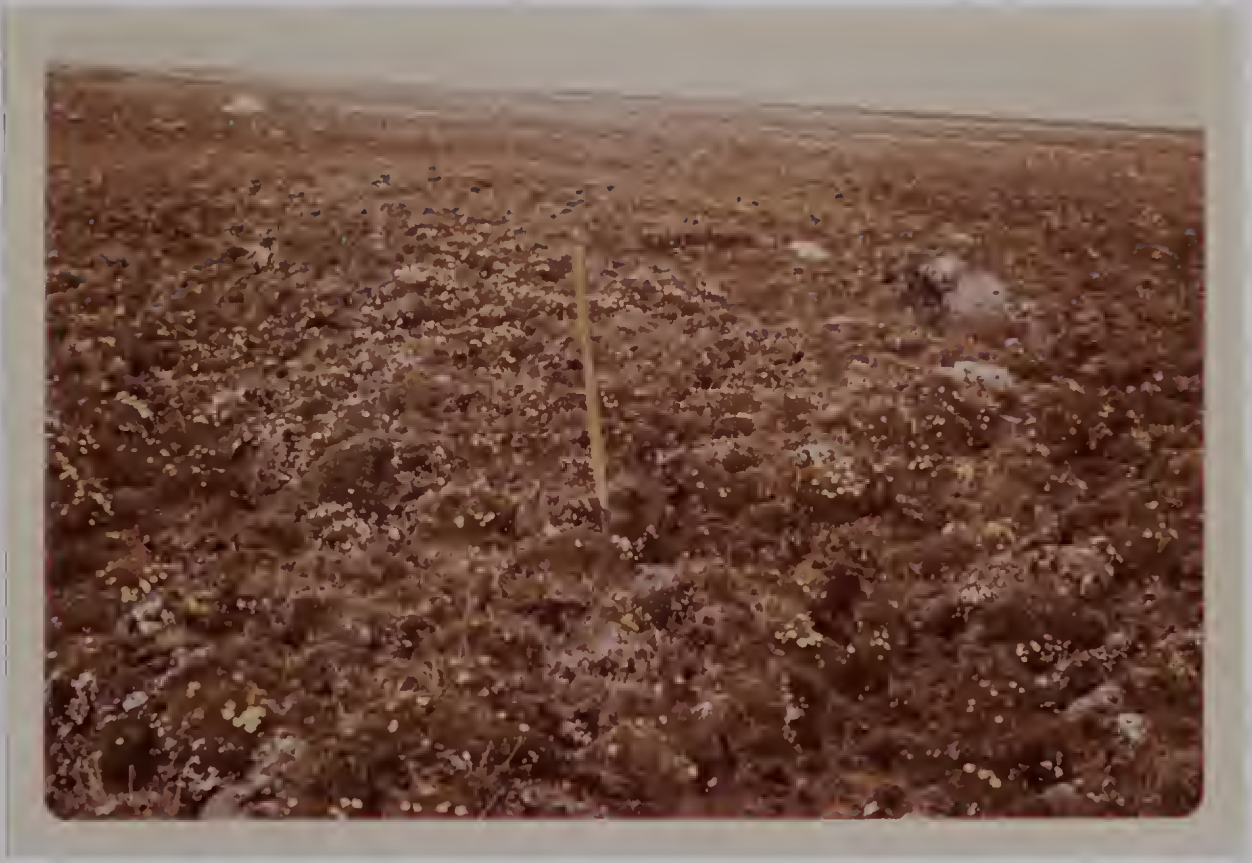


Plate 4. Cushion plant-moss community with micro-earth hummocks.

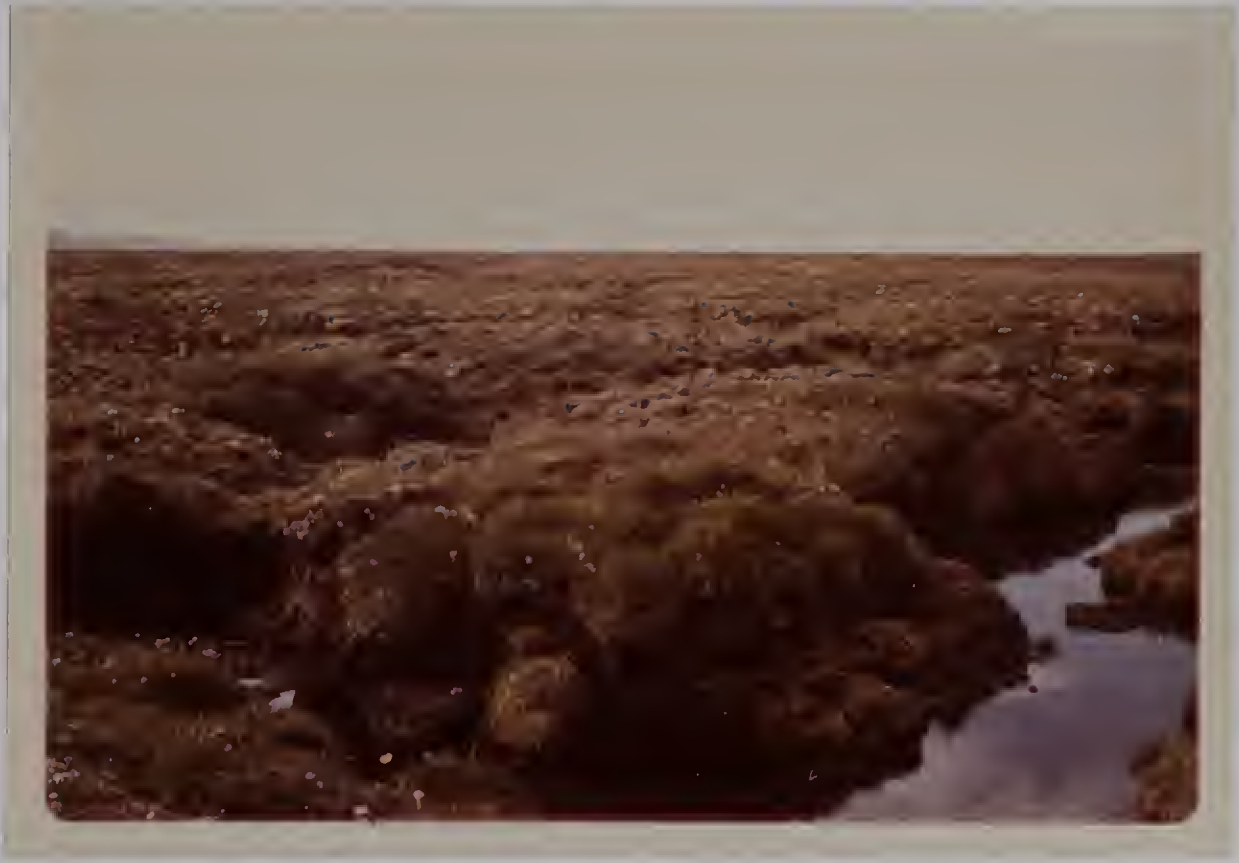


Plate 5. Large ice-wedge polygons located SE of Base Camp on the north shore of Phalarope Lake have a cushion plant-moss type of vegetation.

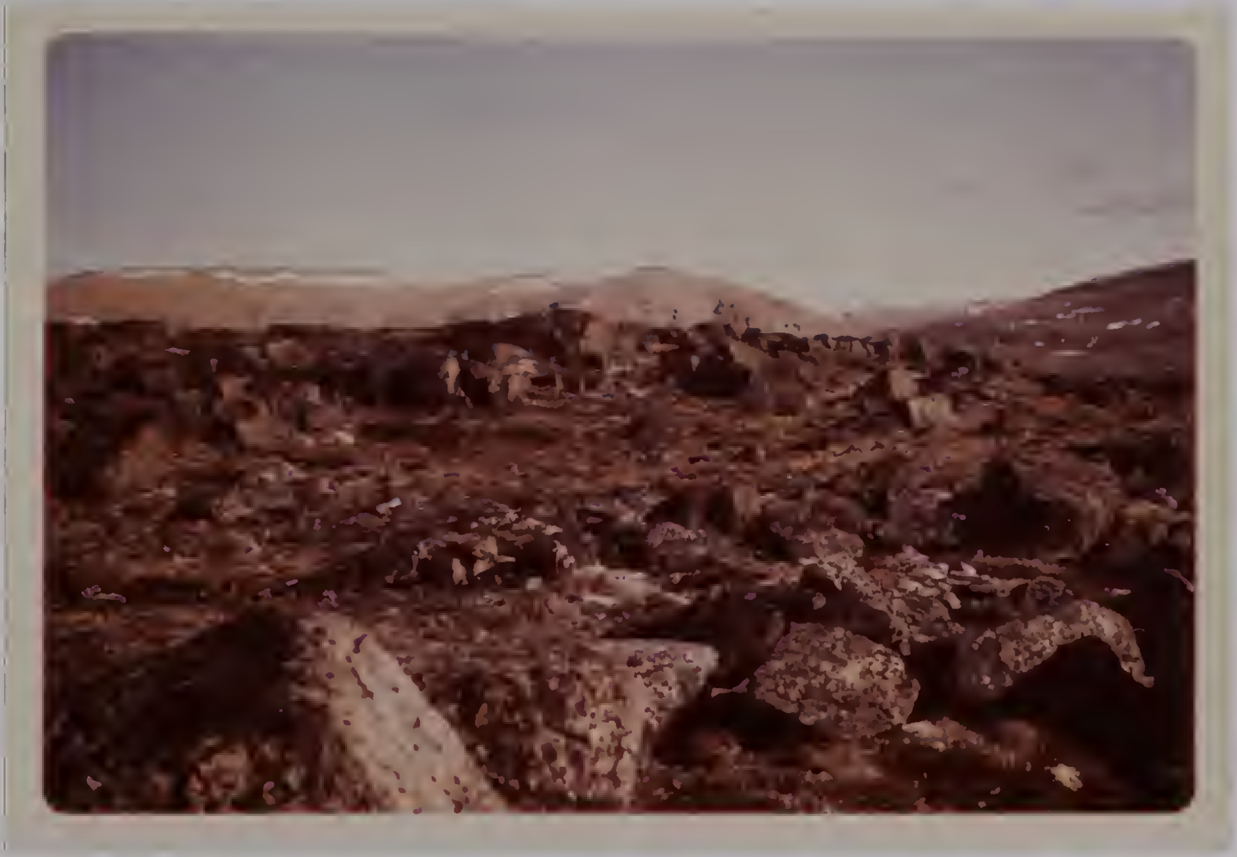
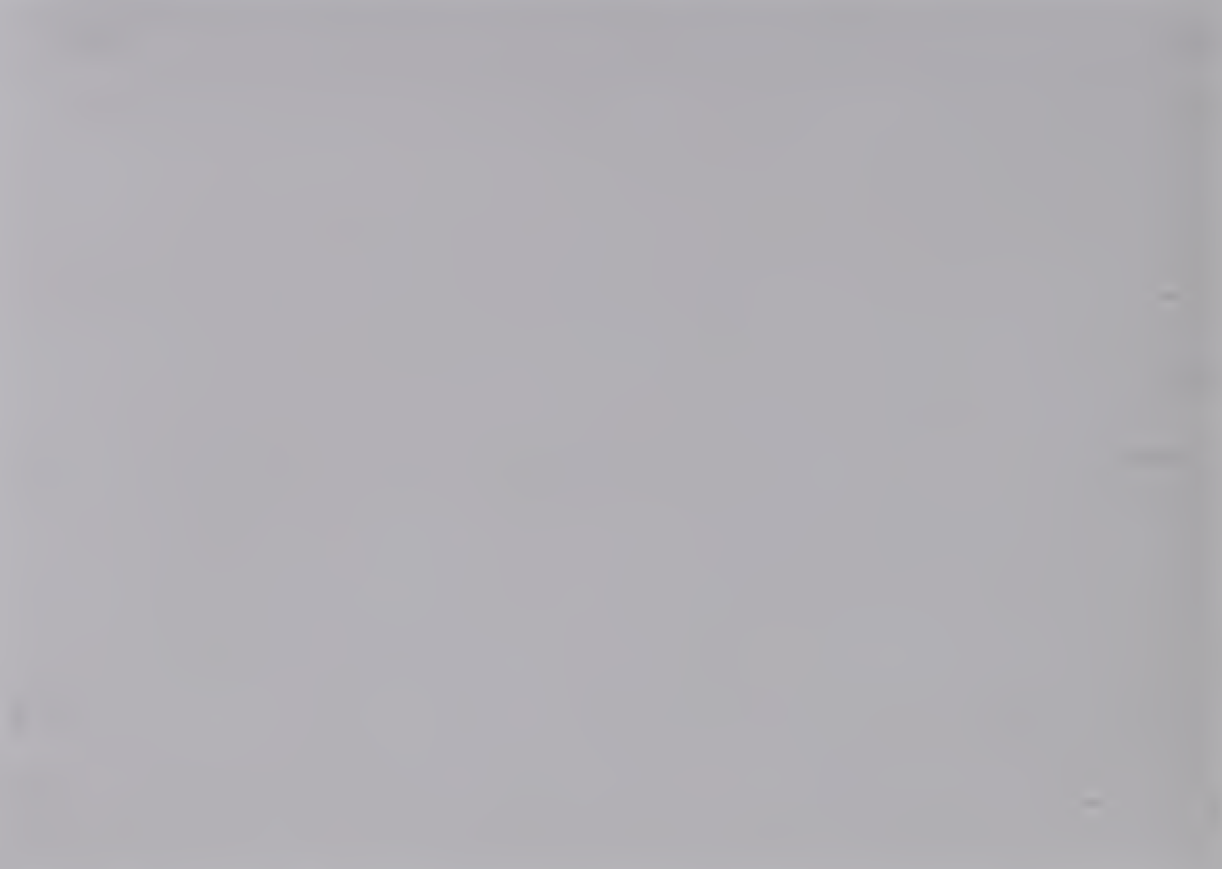


Plate 6. Crystalline rock outcrop area with small, warm habitats having dwarf shrub heath-moss vegetation.



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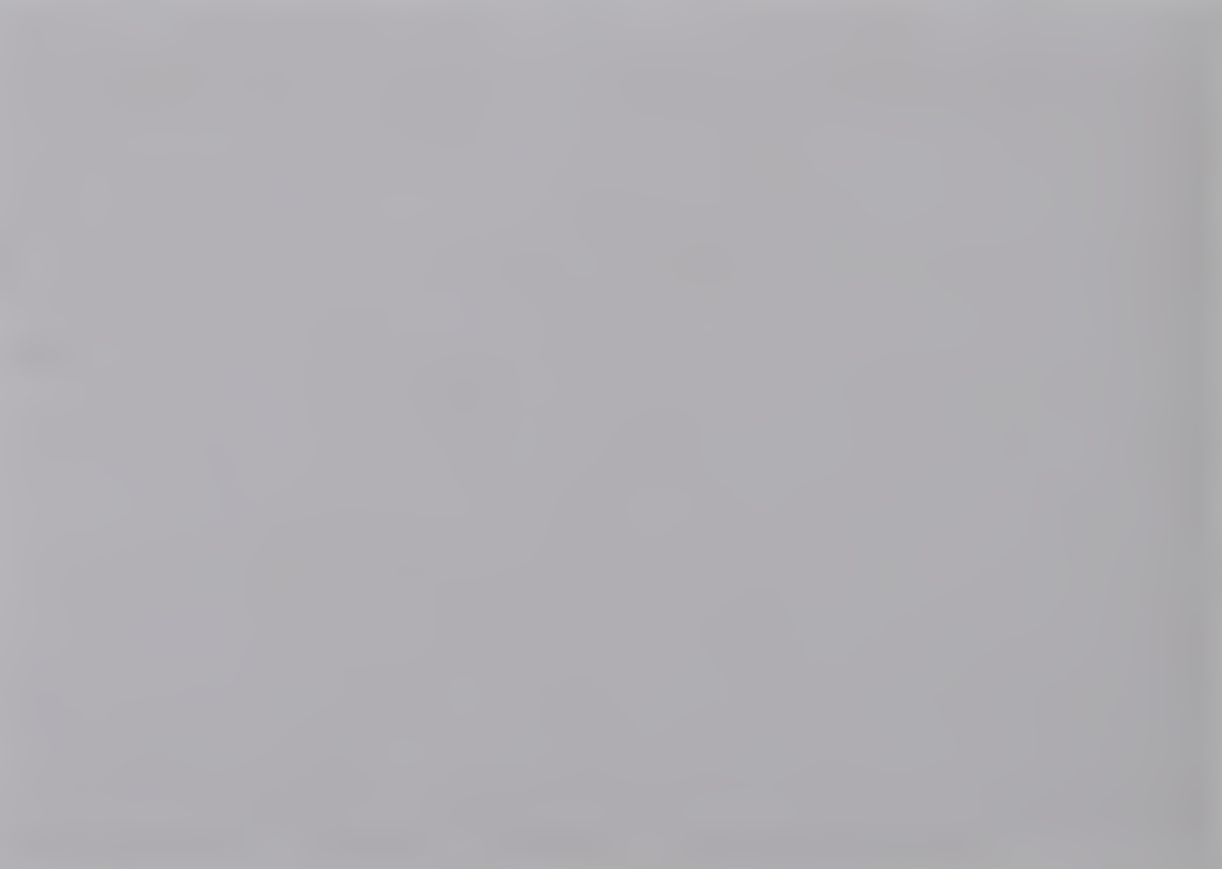

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representative of Polar Desert conditions. Plant cover (<2%) is concentrated in troughs of stripes and other patterned ground meshes and is dominated by mosses. Vascular plants such as *Saxifraga oppositifolia, S. cernua, S. caespitosa, Papaver radicatum, Cerastium alpinum, Draba bellii, Menuartia rubella,* and *Phippsia algida* have rare distribution. *Hypnum bambergii* is the dominant bryophyte; *Ditrichum flexicaule* and *Distichium capillaceum* are common.

Frost-boil sedge-moss meadow is a common community on the Lowland. Frost-boils account for 42% (average) of the surface area and are sparsely vegetated, usually on surface gravel fragments, by bluegreen algae and mosses. On heavily vegetated portions *Eriophorum triste* and *Carex membranaceae* are more abundant than *Carex stans* or *Salix arctica.* The dominant bryophyte is *Drepanocladus revolvens.*

Hummocky sedge-moss meadow (Plate 2) is also very extensive. *Carex stans, Eriophorum angustifolium, Arctagrostis latifolia, and Salix arctia* are abundant vascular plants (provide *ca.* 90% cover). *Cinclidium arcticum* and *Drepanocladus revolvens* are the prevailing bryophytes in a nearly closed moss cover (88%). A distinct hummocky (or ridged) microrelief is typical and attributed to differential growth of mosses. Hummocky graminoid meadow and graminoid-moss meadow, rarely occurring on the Lowland, are included within the hummocky sedge-moss meadow community concept in the soil map legend (back pocket). Small, infrequently occurring areas of late snowmelt with a herb-moss snowbed community are mapped (soil map) with meadow or cushion plant-moss communities.

Wet sedge-moss meadow has a constantly high water table and usually forms in streamside and lake-and pond-shore habitats. *Carex stans* is the abundant vascular plant. *Drepanocladus revolvens, Meecia triquetra,*

Cincidium arcticum, and *Calliergon giganteum* are abundant bryophyte species in the rich, nearly continuous moss cover.

Tidal salt marsh, occupying the narrow coastal fringe, is dominated by *Puccinellia phryganodes.* Included in this concept is unvegetated coastal shoreline with occassional plants of *Cochlearia officinalis.*

Unvegetated rock, scree slopes, and stream channels are identified as "lichen barrens" on the soil map legend. Small pockets of soil with occassional plants of *Saxifraga oppositifolia, S. cernua, Draba bellii, Papaver radicatum,* and *Salix arctica* may occur on the eastern escarpment.

RESULTS AND DISCUSSION

Soil Taxonomy

As previously discussed, the tentative system for northern soils (the Cryosolic Order; C.S.S.C. 1973) is used for classifying, to the subgroup level of abstraction, the soils of the study area. Taxonomic correlation at the subgroup level with three other commonly used North American systems is presented in Table 5. Seventh Approximation (Soil Survey Staff 1960) and Cryosolic Order thickness rules were liberalized, however, to better indicate local pedogenic trends and emphasize the biological importance of organic layers. Consequently the use of "Histic" is qualified by stating that the surface organic layer (assumed continuous in all cases) must occupy, in the vertical dimension, at least 25% of the total active layer thickness and be at least 5 cm thick. Soils lacking vertically continuous mineral horizons within the active layer are classified as organic soils (Pergelic Cryofibrists and Fibric Organo Cryosols). Permafrost consisting of frozen organic material was observed under such soils but few checks concerning depths of organic matter accumulation were made. Further, in those soils classed as Brunisolic Turbic Cryosols, brunisolic features dominate *ca.* 60% or more of the pedon. Miscellaneous soils in unconsolidated fragmental materials are classed as Regosolic Static Cryosols.

The complexity of the Lowland landscape and, in particular, surficial materials necessitated further soil separations within most subgroups. Consequently, several unnamed soil series (C.S.S.C. 1970) were identified. With one exception, soil series are separated on the basis of parent material diversity and can be identified on the soil map legend by comparing subgroup classification taxa and parent material descriptions.

Table 5. Taxonomic correlation at the subgroup level of three classification systems commonly used for soils of the arctic with the tentative system for northern soils (C.S.S.C. 1973) as applied to soils found in the study area.

Tentative System for Northern Soils (C.S.S.C. 1973)	Existing Canadian System (C.S.S.C. 1970, 1973)	Seventh Approximation (Soil Survey Staff 1970)	Great Soil Group(1) (Tedrow & Cantlon 1958, Tedrow *et al* 1958, Tedrow 1968
Brunisolic Turbic Cryosols	Turbic Eutric Brunisols	Pergelic Cryochrepts	
Regosolic Turbic Cryosols	Turbic Orthic Regosols	Pergelic Cryorthents	
Gleysolic Turbic Cryosols	Turbic Rego Gleysols	Ruptic-Histic(2) Pergelic Cryaquepts; Pergelic Cryaquepts	Perhaps: Soil of Polar Desert-Tundra Interjacence(3)
Brunisolic Static Cryosols	Cryic Melanic Brunisols	Pergelic Cryochrepts	Arctic Brown (Miniature or Shallow sub-group); Arctic Brown; Shallow Arctic Brown
Regosolic Static Cryosols	Cryic Orthic Regosols	Pergelic Cryorthents	
Lithic Regosolic Static Cryosols	Lithic Orthic Regosols	Lithic Cryorthents	
Gleysolic Static Cryosols	Cryic Rego Gleysols; Cryic Rego Humic Gleysols	Histic(2) Pergelic Cryaquepts; Pergelic Cryaquept	Meadow Tundra
Fibric Organo Cryosols	Cryic Fibrisols	Pergelic Cryofibrists	Bog or Half Bog
Glacic Fibric Organo Cryosols	Cryic Fibrisols	Pergelic Cryofibrists	Bog

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(1) Subgroup supplied where known.

(2) Organic layers not thick enough to meet the definition of a histic epipedon; therefore its use (histic) is qualified by stating that the organic layer (assumed continuous in all cases) must occupy, in the vertical dimension, at least 1/4 of the total active layer thickness and be at least 5 cm (2 inches) thick.

(3) Tedrow 1970.

The one exception involves distinguishing the Brunisolic Static Cryosol of Map Units 11 and 21 from the Brunisolic Static Cryosol of Map Unit 12 primarily on the basis of a dissimilar plant community - drainage (or moisture regime) relationship that has resulted in minor soil morphology differences. Of the 27 soil series plus miscellaneous land types identified, two belong to the interior plateau and one separates this upland from the Lowland proper.

Map Unit Concepts

The complexity of the Truelove Lowland terrain in conjunction with the mapping scale used necessitated rearrangement of the 19 "soil series" and 8 miscellaneous soils to form 24 map units, most of which represent unnamed soils separated at a level corresponding to soil series. However, eight map units represent soil complexes in which two "soil series" (soil association in American terminology; Anon. 1973) or a "soil series" and a miscellaneous soil are so intimately intermixed geographically that it is practical to separate them only at scales larger than 1:5,000.

A second level of complexing was necessitated by landscape complexity, interpretation difficulties, and the scale of mapping. Consequently, many of the soil areas delimited on the map are identified by hyphenated map units (a maximum of three for any one soil area) arranged in descending order of dominance. Inclusions of other map units up to 15% are disregarded.

Slope classes (C.S.S.C. 1970, 1974) are indicated by map symbol denominators and represent the dominant or overall slope for any soil area. Complex and simple slopes were not differentiated. As a general rule complex slopes are associated with raised beach landforms, outwash, Lowland till, and crystalline rock outcrops. Slope classes are not provided for the crystalline rock outcrop unit (map unit 83) because of extreme slope

variability.

Map unit descriptions center around conceptual pedons. In most cases, variation in map unit characteristics are also depicted. Sampled soil individuals, deemed most closely resembling the conceptual type pedons, are described (with accompanying analytical data) as part of the more important map unit portrayals. Additional profile descriptions and analytical data are contained in the Appendix. The map legend (back pocket) provides the map unit numbering sequence and basic information on subgroup classes, parent material features (reaction, calcareousness, and texture), landforms, drainage classes, associated periglacial features, and associated vegetation.

Map Units With Regosolic and Brunisolic Static Cryosols

Seven map units (refer to map legend), characterized by relatively free drainage (rapidly to moderately well drained; C.S.S.C. 1970) and Regosolic and/or Brunisolic Static Cryosols, are described in this section. Map Units 11, 12, 13, 21, and 81 are associated with beach deposits; 22 with outwash; and 83 with crystalline bedrock. Chemical features and pedogenic trends of the soils in these units are briefly described in two sections following this descriptive section.

Map Units 11 and 21

Both these map units, each representing a soil complex, are associated with slope and crest positions of raised beach landforms containing Bd 1 beach material. Cushion plant-lichen vegetation and rapidly to well drained conditions are characteristic. The more commonly occurring, soil map unit 11, is dominated by Brunisolic Static Cryosols with subdominant Regosolic Static Cryosols. Order of dominance is reversed in map unit 21.

Figures 7 and 8 are diagrammatic cross-sections of two raised beaches, the first representing map unit 11 and the second, map unit 21. Regosolic Static Cryosols (Ahk, Ck, Cz horizon sequence; Plate 7) commonly occupy crest positions and show a range in development from profiles lacking Ah horizons (ochric epipedons) to profiles bordering on the types of development that may be classed as Brunisolic Static Cryosols. A typical Regosolic Static Cryosol is described in Table 6.

Table 6. A Regosolic Static Cryosol (Pergelic Cryorthent), from sampling site 39 (see Fig. 2), considered representative of map units 11 and 21.

Sampling Date: July 9, 1971

Approximate Elevation and Age: 28 m AMSL; 7500 years B.P.

Site Position: Ridge crest

Drainage Class: Rapidly drained

Landform and Parent Material: Raised beach (crest zone); Bd 1 beach material

Vegetation: Cushion plant-lichen community (Muc and Bliss 1976)

	0-2 cm; poorly developed desert pavement, mainly gravels.
Ahk	2-13 cm; dark brown (7.5 YR 3/2 m*) very gravelly sand; single grain; loose; abundant, very fine and fine roots; clear, smooth boundary; 11 ± cm thick; moderately alkaline.
Ck	13-82 cm; very gravelly sand to very gravelly loam sand; single grain; loose; plentiful very fine roots to 33 cm; abrupt smooth boundary; 69 ± 8 cm thick; moderately alkaline.
Cz	82 plus cm; frozen gravels and sands.

Remarks: A color value is not provided for the Ck horizon because individual grain colors prevail and no uniform matrix color exists. Random stratification of sands and gravels occurs throughout the profile. The Ck horizon becomes moist at about 5 cm above the frost table.

* m = moist color

In more favorable positions, on slopes and broad, flat tops of raised beaches, Brunisolic Static Cryosols (Table 7, Plate 8) are more likely to occur. These soils have under increased plant cover, Ah horizons with increased humus content and weak B horizons (Cambic horizons)

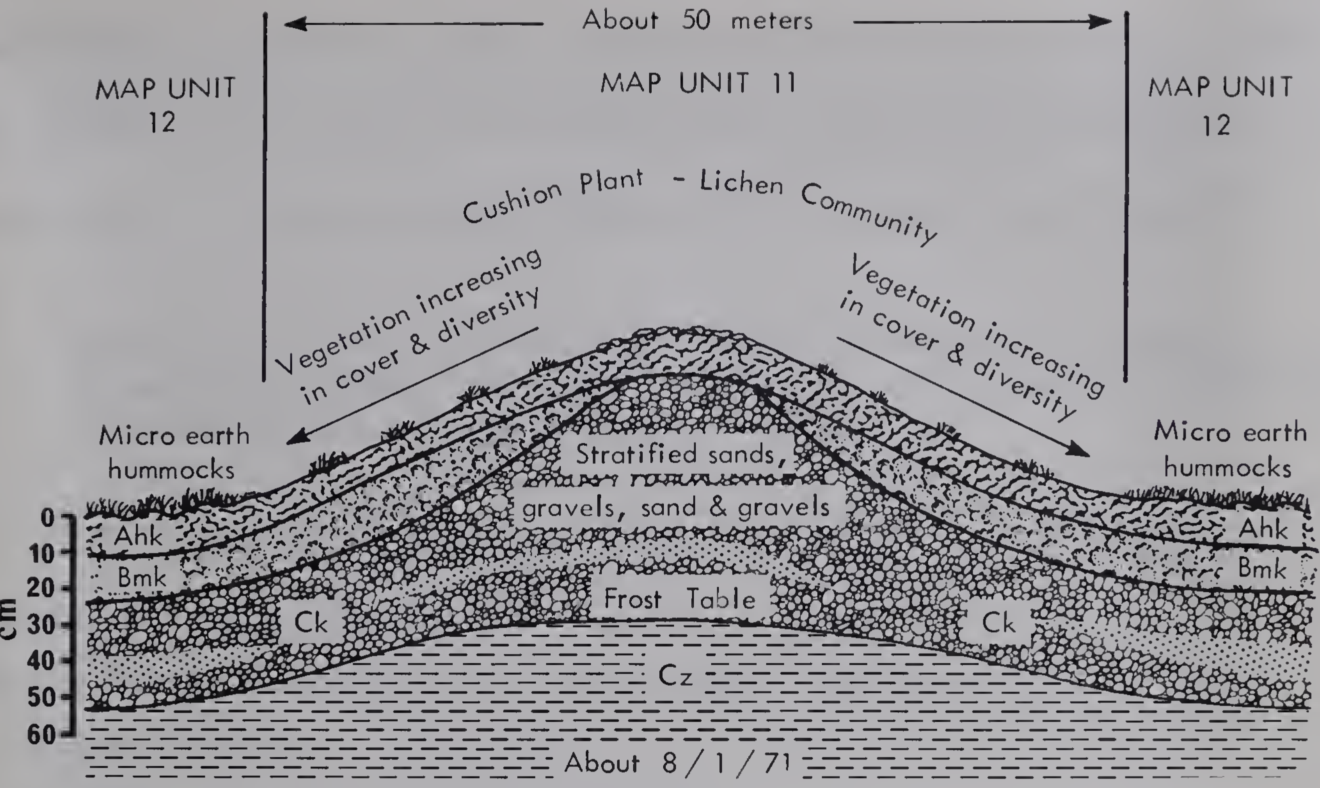
About 50 meters
MAP UNIT 12
MAP UNIT 11
MAP UNIT 12
Cushion Plant - Lichen Community
Vegetation increasing in cover & diversity
Vegetation increasing in cover & diversity
Micro earth hummocks
Micro earth hummocks
Stratified sands, gravels, sand & gravels
Ahk
Bmk
Ck
Frost Table
Ck
Ahk
Bmk
Cz
About 8 / 1 / 71
0
10
20
30
40
50
60
cm

Figure 7. Diagrammatic cross-section of a raised beach designated as belonging to map unit 11. Brunisolic Static Cryosols (Ahk, Bmk, Ck, Cz horizon sequence) dominate. Regosolic Static Cryosols (Ahk, Ck, Cz horizon sequence) are subdominant.

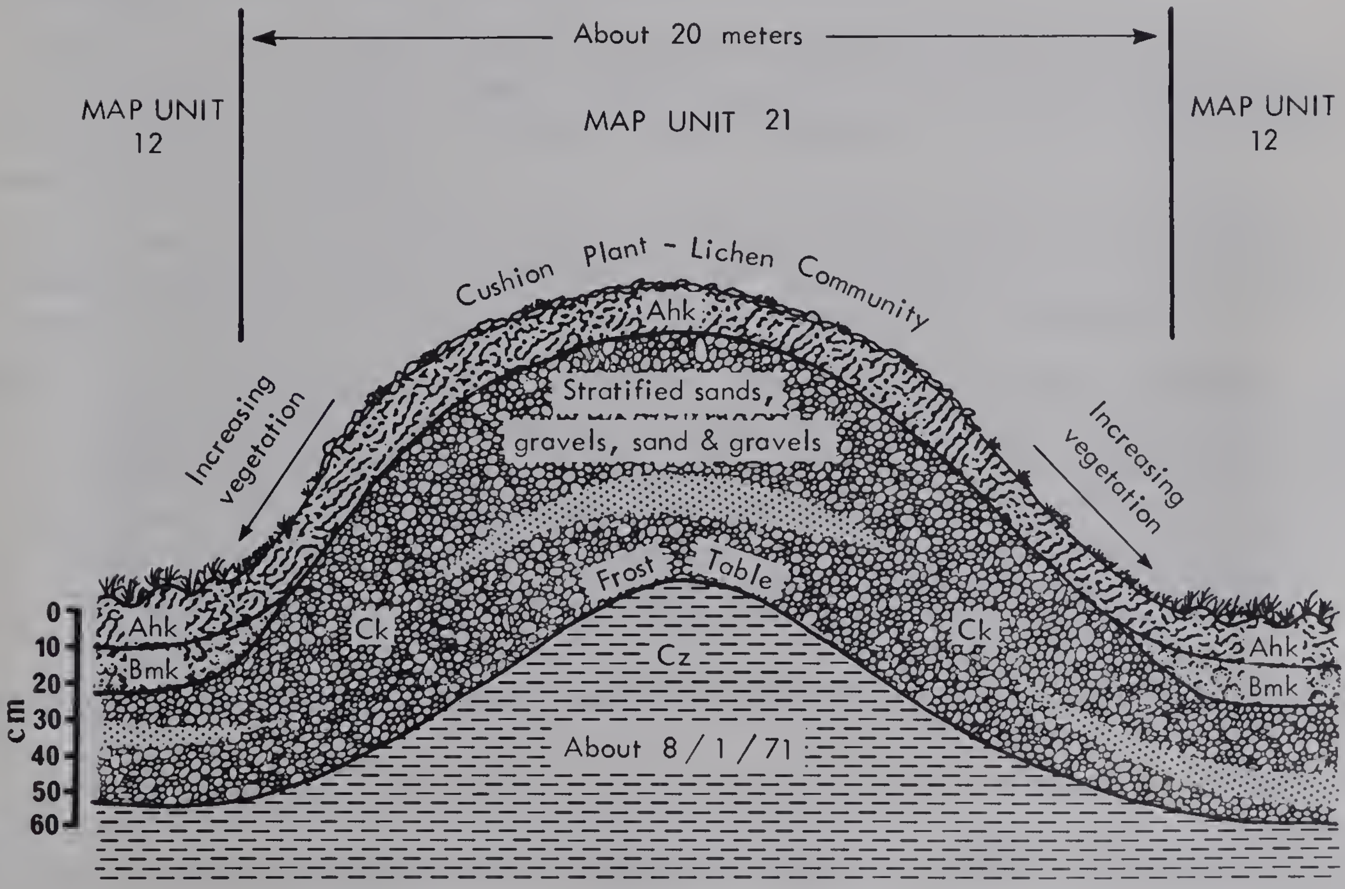

Figure 8. Diagrammatic cross-section of a raised beach designated as belonging to map unit 21. Regosolic Static Cryosols (Ahk, Ck, Cz horizon sequence) dominate. Brunisolic Static Cryosols (Ahk, Bmk, Ck, Cz horizon sequence) are subdominant.

that have been enriched by small amounts of mobile humus forms. They are usually bounded, down slope, by similar soils displaying stronger development (map unit 12) and occurring under cushion plant-moss vegetation.

Table 7. Brunisolic Static Cryosol (Pergelic Cryochrept), from the intensive raised beach site - Plot 8A (see Fig. 1), considered representative of map units 11 and 21.

Sampling Date: July 26, 1971

Approximate Elevation and Age: 28 m AMSL; 7500 years B.P.

Slope Class and Aspect: C: WSW

Drainage Class: Well to rapidly drained

Landform and Parent Material: Raised beach (slope zone);
Bd 1 beach material

Vegetation: Cushion plant--lichen community (Muc and Bliss 1976)

LF	2-0 cm; discontinuous litter layer occurring beneath cushion plants; contains some eolian sands.
Ahk	0-10 cm; very dark brown (10 YR 2/2 m) sand; single grain; soft; abundant, very fine and fine random roots; abrupt; smooth boundary; 10 ± 3 cm thick; mildly alkaline.
Bmk	10-26 cm; very dark grayish brown to dark brown (10 YR 3/2 - 3/3 m) very gravelly sand; single grain; loose; plentiful, very fine vertical roots; gradual, wavy boundary; 13 to 21 cm thick; moderately alkaline.
Ck	26-62 cm; very gravelly sand; single grain; loose; few, very fine roots to 35 cm; very few, very fine roots to 46 cm; abrupt, smooth boundary; 33 to 40 cm thick; moderately alkaline.

Remarks: A color value is not provided for the Ck horizon because individual grain colors prevail and no uniform matrix color exists. Sands and gravels are randomly stratified throughout the profile. The Ck horizon becomes quite moist at about 15 cm above the frost table. The B horizon of this individual has less organic matter than the modal pedon (*ca.* 1% org. carbon).

Raised beaches belonging to map unit 21 are usually narrower, have steeper but more rounded slopes and tops, and are elevated higher above adjacent land than those belonging to map unit 11 (Fig. 8 vs. Fig. 7). Small depressions, characterized by Brunisolic Static Cryosols similar to

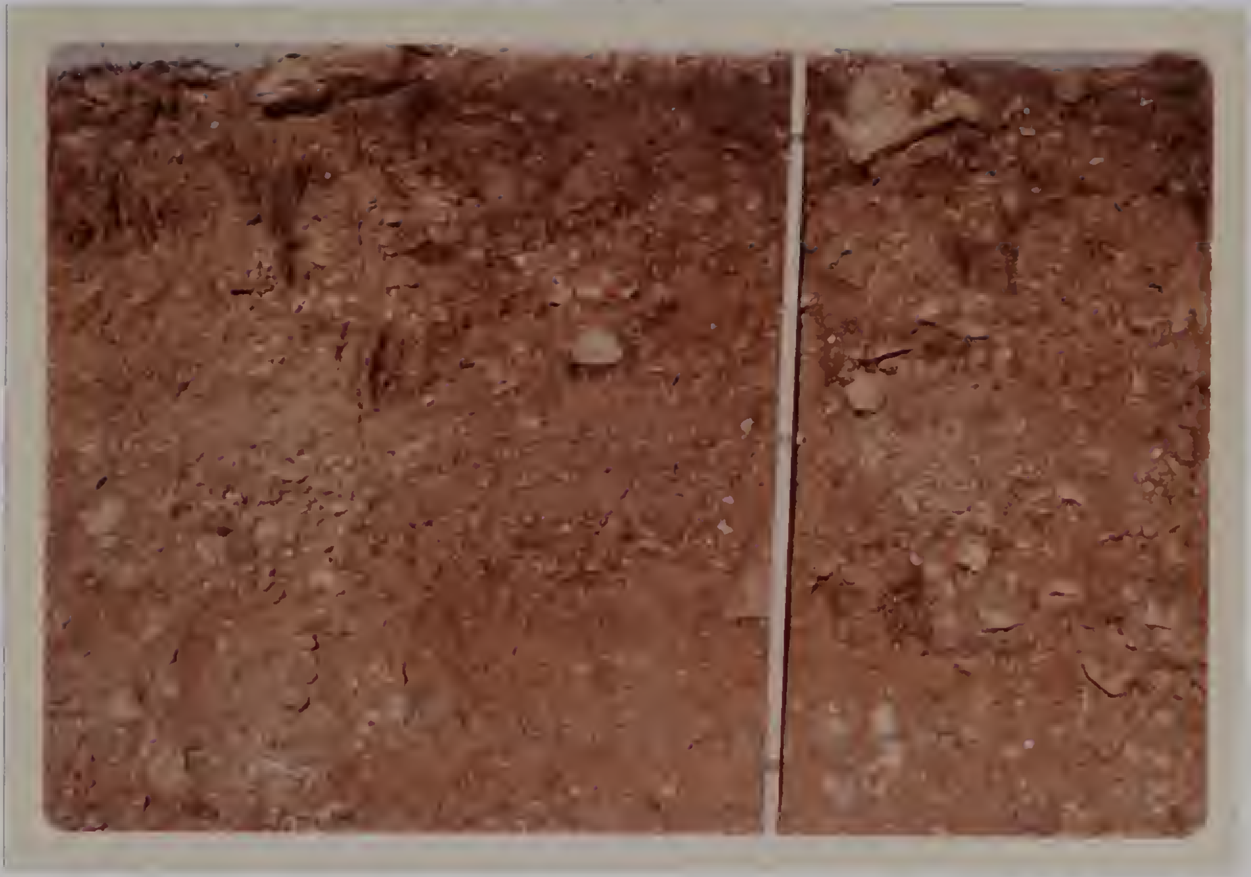

Plate 7. Regosolic Static Cryosol (Site 16) of map units 11 and 21. Black bands on tape mark 1 foot intervals.

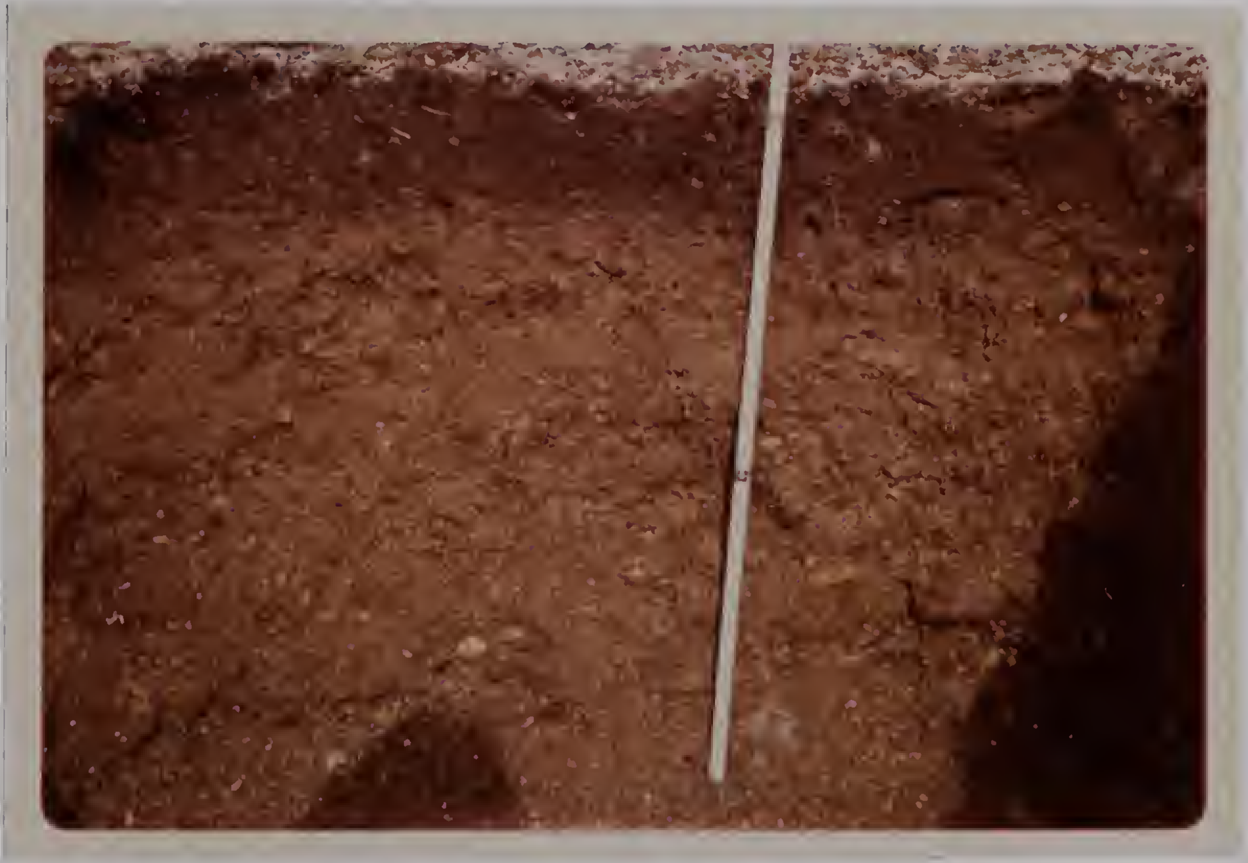

Plate 8. Brunisolic Static Cryosol (Raised beach site - Plot 8A) of map units 11 and 21. Bmk horizon is nearly imperceptible in this photograph. Tape end is resting on permafrost.

those of map unit 12, are infrequent inclusions associated with map unit 11. Likewise, ice-wedge fissures, generally sufficiently far apart that polygonal patterns are not formed, are considered as common inclusions in both map units. These ice-wedge fissures have developed, on a micro scale, a soil and vegetation sequence similar to that of "tri-zonal" (crest, slope, transition) raised beaches (Plate 9). Active layer depths range from 0.6 to 1.0 m in these two map units.

Map Unit 12

Map unit 12 occupies lower slope positions of raised beaches or all of those raised beaches having very low relief and is characterized by Brunisolic Static Cryosols developed in Bd 1 beach material (Plate 10) under cushion plant-moss vegetation and moderately well drained conditions. This map unit identifies a habitat type that is considered transitional between raised beach proper and meadow. It belongs to raised beach landforms and forms the third (bottom slope) zone of "trizonal" raised beaches (Fig. 7, Plate 9).

Soil characteristics range between those of Brunisolic Static Cryosols of map unit 11 and those of the gleyed mineral soils characterizing most meadows. "Snowpatch" habitats and their gleyed Brunisolic Static Cryosols are often included. In many cases, profile textures are not as gravelly as in the two soils of map units 11 and 21.

The modal pedon of map unit 12 (Table 8) displays darker colored A and B horizons (increased humus contents) and stronger solum development than the most closely related soil, the Brunisolic Static Cryosol of map units 11 and 21. Soils having Ah horizons replaced by thicker FH or H (organic) horizons are included within the limits of map unit 12. Micro-earth hummocks (less than 10 cm high and 20 cm across; Plate 4) may occur

on the soil surface; their presence appears related to specific vegetation types. Maximum active layer thicknesses range between 0.5 and 0.7 m.

Table 8. A Brunisolic Static Cryosol (Pergelic Cryochrept), from sampling site 11 (see Fig. 2), considered representative of dominant soils in map unit 12.

Sampling Date: August 12, 1971

Appromixate Elevation and Age: 28 m AMSL; 7500 B.P.

Slope Class and Aspect: C; W

Drainage Class: Moderately well drained

Landform and Parent Material: Raised beach (lower slope, transition zone) Bd 1 beach material.

Vegetation: Cushion plant-moss community (Muc and Bliss 1976)

LFH 2-0 cm; black (10 YR 2/1 m) litter layer occurring beneath cushion plants and mosses.

Ahk 0-8 cm; black (10 YR 2/1 m) gravelly sandy loam; single grain; very friable; plentiful, very fine and fine roots; abrupt, smooth boundary; pH 7.1.

Bmk 8-23 cm; very dark grayish brown to dark brown (10 YR 3/2 - 3/3 m) very gravelly loamy sand; single grain; loose; plentiful, very fine and fine roots; clear, wavy boundary; pH 7.7.

Ck 23 plus cm; very gravelly sand; single grain; loose; very few, very fine roots to 36 cm; cobbles and stones increasing in quantity with depth; pH 7.8.

Remarks: The landform in which this site occurs is a long inclined slope of beach material lying against a large rock outcrop. This slope provides drainage of higher land to the east. Although the solum is considered typical of Brunisolic Static Cryosols in map unit 12, vegetation at this site is not characteristic of the cushion plant-moss community type in which it is grouped. A color value is not provided for the Ck horizon because individual grain colors prevail and no uniform matrix color exists. Sands and gravels are randomly stratified throughout but cobbles and stones increase in number with depth such that excavation was restricted to 61 cm. Free water was encountered at 53 cm.

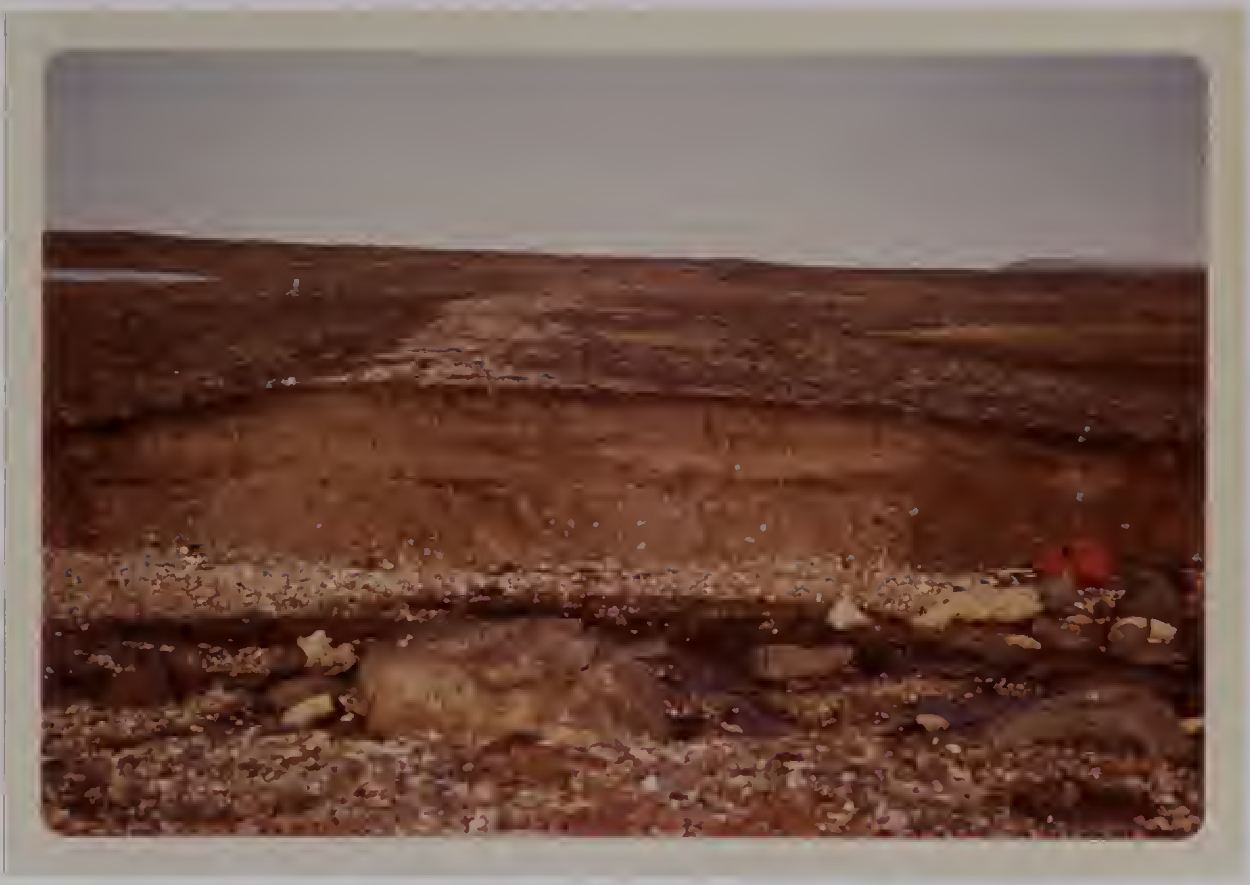

Plate 9. Cross-section of a "trizonal" raised beach (Sites 16, 17) with a very narrow crest zone, a slightly wider slope zone to the right of the crest, and transition zone (dominant) on both sides (left and right, middle ground).

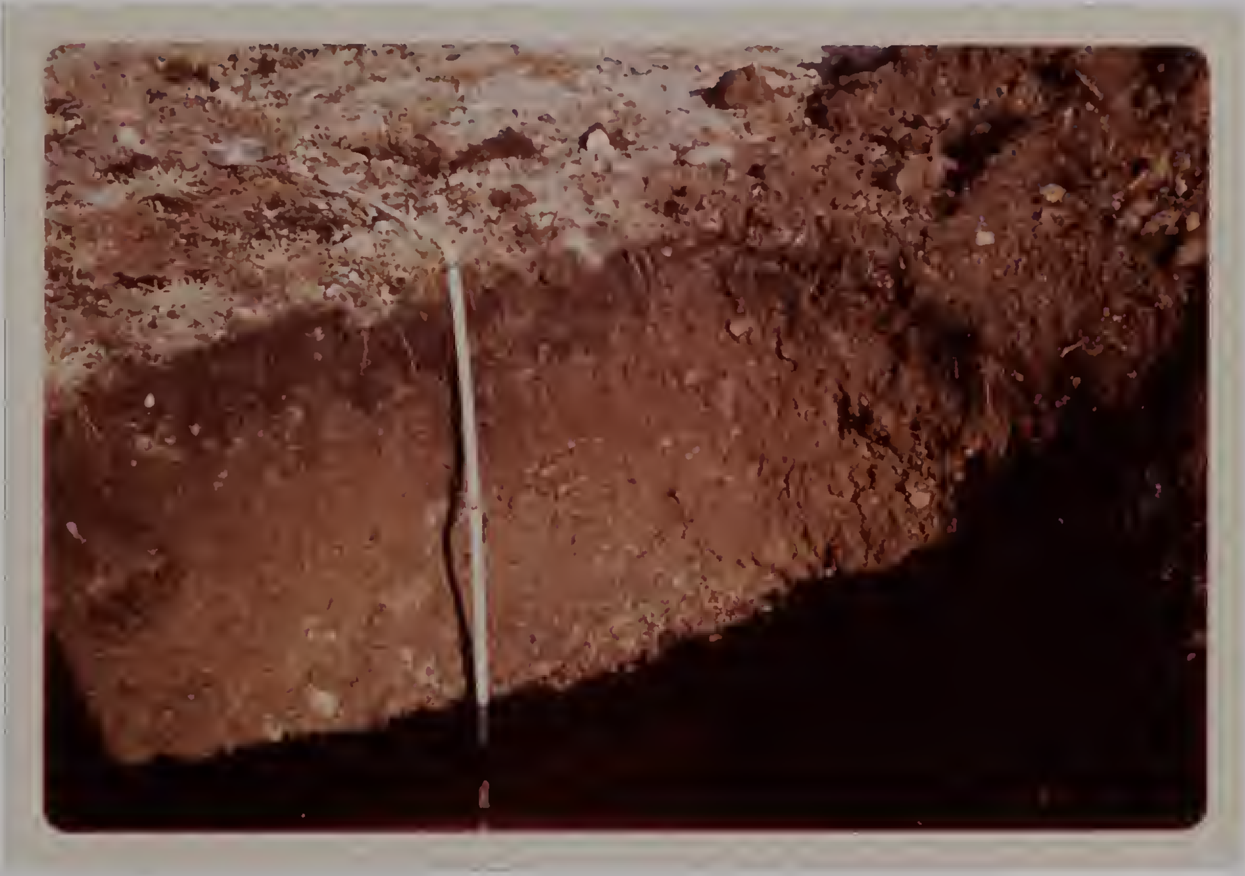

Plate 10. Brunisolic Static Cryosol (Site 11) of map unit 12. Note the lightening of colors with increasing depth.

Map Unit 13

Map unit 13 is dominated by Brunisolic Static Cryosols developed in Bd 2 beach material that thinly mantles portions of some rock outcrops. Although a type of profile development similar to the Brunisolic Static Cryosols of map unit 11 and 12 is considered to be dominant and modal, map unit 13 has much broader limits than those discussed above and includes soils with stronger development (analogous to the Brunisolic Static Cryosols of map unit 12) as well as Regosolic Static Cryosols.

Map Unit 22

Except for landform and parent material type, this map unit resembles, very closely, map unit 21. The dominant soil, Regosolic Static Cryosols developed in coarse-skeletal, fluvial outwash (Ow 2), is generally weaker, having very weak or no Ah horizons. Brunisolic Static Cryosols are considered as minor inclusions rather than subdominant soils.

Map Unit 81

Raised beaches, 3300 years old and younger and composed of angular to thin, flat dolomitic gravels and cobbles (Bd 3), belong to map unit 81. This material is recognized as rubble land rather than soil, however, partially fragmental Regosolic Static Cryosols, similar to profile 32, (Table 9, Plate 11), are designated as being subdominant in the map unit. Within the age range specified above, older raised beaches tend to have soils approaching this type of development.

Table 9. A Regosolic Static Cryosol (Pergelic Cryorthent), from sampling site 32 (see Fig. 2), considered representative of subdominant soils in map unit 81.

Sampling Date: August 14, 1972

Approximate Elevation and Age: 4 m AMSL: 3300 years B.P.

Site Position: Crest of a raised beach

Drainage Class: Rapidly drained

Parent Material: Rubbly beach material (Bd 3) overlying Bd 1 beach material

Vegetation: Cushion plant-lichen community on rubble (Muc and Bliss 1976)

Rubble	0-32 cm; angular to thin, flat fragments of gravel and cobble sizes; dolomite origin; estimated coarse fragments 90-100% thin calcite films on undersides of many fragments; abrupt, smooth boundary.
$IICk_1$	32-45 cm: very gravelly sandy loam; loose; clear, smooth boundary; 13 ± 5 cm thick; estimated coarse fragments 50-60%; $CaCO_3$ equivalent 86.0%; no organic C; pH 7.9.
$IICk_2$	45-75 cm; very gravelly sand; loose; abrupt, smooth boundary; 30 ± 7 cm thick; estimated coarse fragments 70-80%; $CaCO_3$ equivalent 55.9%; pH 8.2.
Cz	75 plus cm; frozen beach material.

Remarks: No colors are provided for the IICk horizons because individual grain colors prevail and no uniform matrix colors exist.

Map Unit 83

Outcroppings of crystalline rock (Rc) form jagged, irregular-shaped knobs or buttes that are prominent, characteristic features of the Truelove Lowland. These crystalline rock outcrops, excepting limited areas which are overlain by beach materials (Map unit 13), belong to soil map unit 83 and are dominated by consolidated bedrock and lichen vegetation. Small, locally depressed niches characterized by dwarf shrub heath-moss vegetation (Plate 6) and Lithic Regosolic Static Cryosols (Table 10, Plate 12) developed in frost-shattered residual materials (Rc2) occupy an esti-

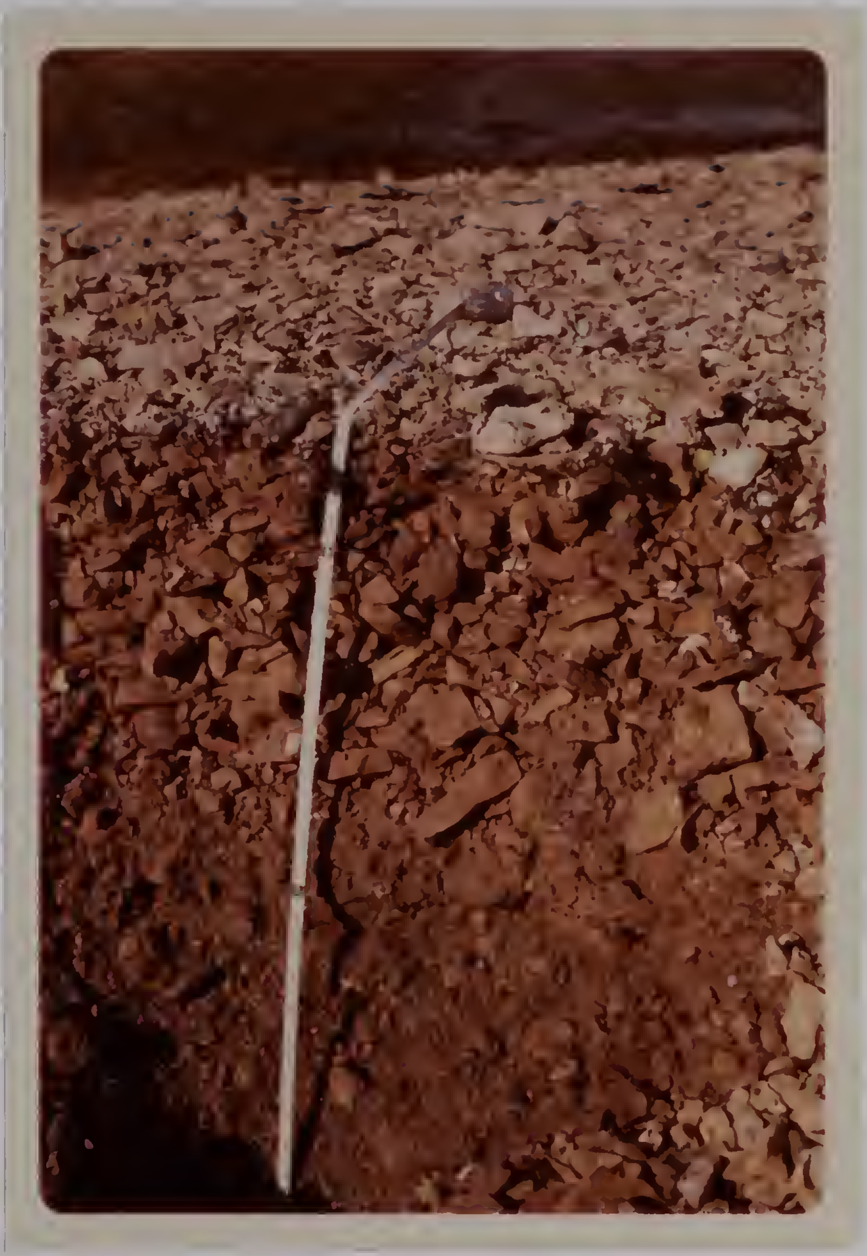

Plate 11. Regosolic Static Cryosol (Site 32) subdominant in map unit 81.

mated 15 to 40% of rock outcrop units. These soils, designated as subdominant in the map unit, vary with respect to depth of solum, depth of horizons, and organic matter content of horizons. Ah horizons show some horizontal and vertical variation with respect to color, content of coarse fragments, and concentration of organic matter. This indicates that some degree of frost activity affects these soils. B (cambic) horizons, produced by slight chemical alteration, were not found in such microsites but their occurrence could be expected in such niches where residual material is deeper and contains less coarse fragments.

Table 10. A Lithic Regosolic Static Cryosol (Lithic Cryorthent), from sampling site 8 (see Fig. 2), considered representative of subdominant soils in map unit 83.

Sampling Date: July 28, 1971

Approximate Elevation: 32 m AMSL

Site Position and Aspect: Small, level niche in the middle slope section of a steeply sloping rock-outcrop; SSW

Drainage Class: Moderately well to well drained

Landform and Parent Material: Crystalline rock outcrop; residual crystalline material (Rc 2) overlying bedrock (Rc 1)

Vegetation: Dwarf shrub heath-moss community (Muc and Bliss 1976)

L	7-5 cm; undecomposed litter.
FH	5-0 cm; black (10 YR 2/1 m) moderately to well decomposed organic matter; abundant, very fine and fine roots; abrupt, broken boundary; 0 to 8 cm thick; slightly acid.
Ah_1	0-5 cm; very dark grayish brown (10 YR 3/2 m) sandy loam; single grain; loose; plentiful, very fine and fine roots; clear, broken boundary; 0 to 10 cm thick; neutral.
Ah_2	5-31 cm; very dark brown to very dark grayish brown (10 YR 4/2-3/2 m) very gravelly sandy loam; single grain; loose; few, very fine roots; abrupt, wavy boundary; 15 to 28 cm thick; mildly alkaline.
R	31 plus cm; lithic contact composed of closely spaced stones and boulders.

Remarks: Within Ah horizons there is some horizontal variation with respect to colors and concentrations of organic matter and coarse fragments. The presence of a few dolomite erratics suggests that this deposit may in fact be glacial.

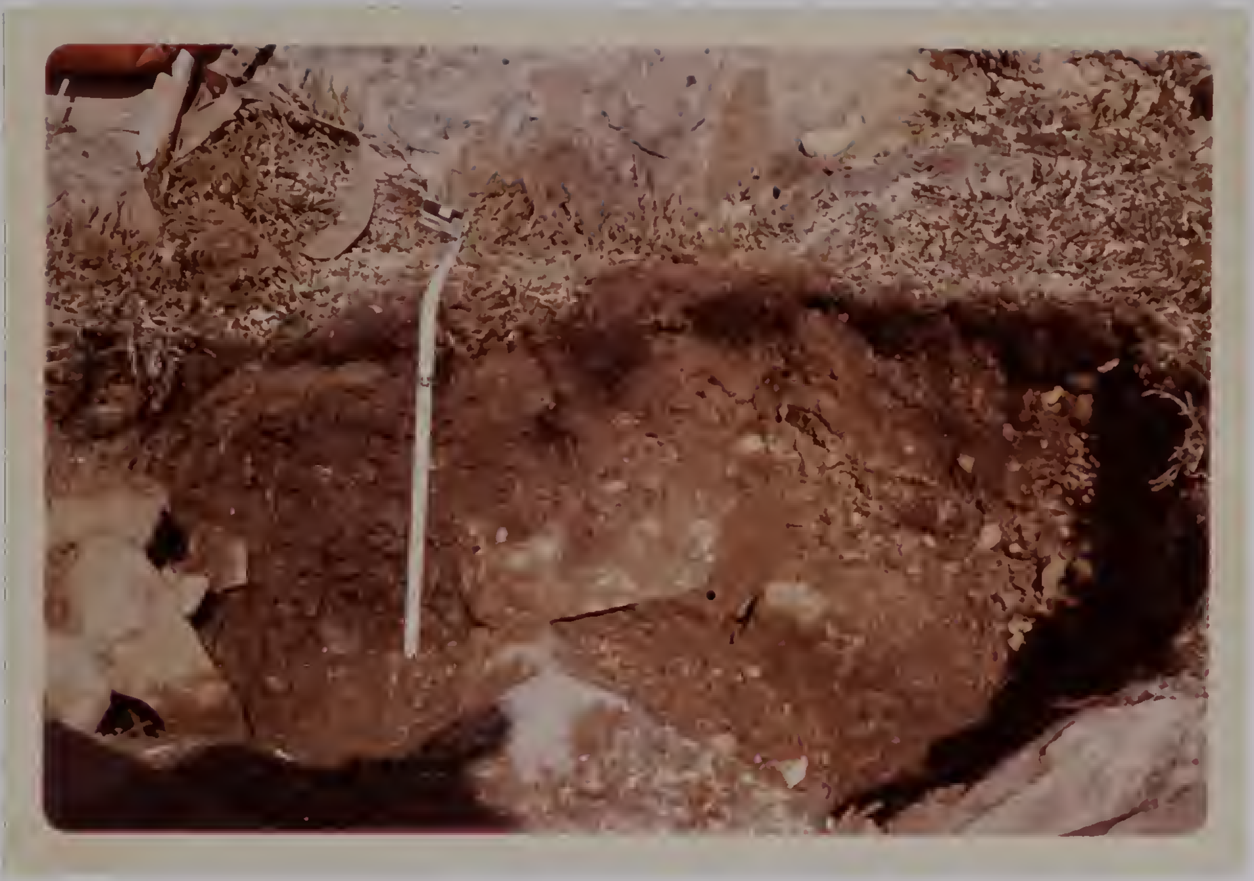

Plate 12. Lithic Regosolic Static Cryosol (Site 8) subdominant in map unit 83.

Analytical Features of Regosolic and Brunisolic Static Cryosols

Table 11 presents physical and chemical data for most of the Regosolic and Brunisolic Static Cryosol profiles described in the preceding section. Following is a very brief summary of some of these data. Furthur examination of the analytical data (Table 11) occurs in the following section on pedogenic trends.

Total nitrogen correlates with organic matter accumulation and, to a lesser extent, habitat conditions. Consequently, driest sites with weakly developed soils (Site 39 and intensive raised beach site - Plot 8A) have, in surface organo-mineral horizons, C/N ratios of about 30 to 1. More moist sites with nearly continuous plant cover and more advanced soils in terms of organic matter accumulation, translocation, and, possibly, decomposition (Sites 8 and 11) display, throughtout their sola, C/N ratios in the order of 10-15 to 1.

Base saturation in these soils is high (85-100%) even in slightly acid horizons. The dominant cations, Ca and Mg, reflect the dominating influence of dolomite in the environment. The adsorption complex is primarily a function of organic matter as shown by the relationships between total exchange capacity and organic carbon values (note Site 8).

Available nutrient status of these soils is very low. Only the surface horizon at Site 8, occupying a micro-climatically favorable habitat (comparatively warm and moist), shows relatively higher contents of available nitrate-nitrogen, phosphorus, potassium, and sodium and water soluble sulfate-sulfur.

Pedogenic Trends in Regosolic and Brunisolic Static Cryosols

Morphologic features and some of the analytical data (Table 11) invite discussion on pedogenic trends in Regosolic and Brunisolic Static

Table 11. Chemical and physical data for selected Brunisolic and Regosolic Static Cryosols

Horizon	Depth (cm)	pH	Org. Carbon %	Total N %	$CaCO_3$ Equiv. %	Exchangeable Cations (me/100g)					T.E.C. (me/100g)	Available Nutrients (ppm)					Oxalate		% Coarse Fragments (>2mm)	Particle Size Distribution (% of <2mm fraction)			Bulk Density (gm/cc)
						H	Ca	Mg	Na	K		NO_3-N	P	K	Na	SO_4-S	Fe %	Al %		Sand (2.0 - 0.05mm)	Silt (0.05 - 0.002mm)	Clay (<0.002 mm)	
Site 39 -- Regosolic Static Cryosol in beach material (Bd 1) -- representative of map units 11 and 21:																							
Ahk	2-13	8.1	1.2	0.04	11.7	-	-	-	-	-	-	2	1	8	2	3.8	0.05	0.05	65	88	10	2	1.6
Ck	13-34	8.3	0.0	0.04	19.7	-	-	-	-	-	-	0	1	6	1	1.0	0.02	0.00	77	84	16	0	1.6
Ck	34-59	8.3	0.0	0.01	20.3	-	-	-	-	-	-	0	1	5	2	1.0	0.01	0.00	75	93	6	1	1.7
Ck	59-82	8.3	0.0	0.01	18.6	-	-	-	-	-	-	0	1	5	0	0.5	0.01	0.00	58	95	5	0	1.6
Intensive Raised Beach Study Site (Plot 8A) -- Brunisolic Static Cryosol in beach material (Bd 1) -- representative of map units 11 and 21:																							
Ahk	0-10	7.8	3.7	0.12	9.6	-	-	-	-	-	-	1	1	12	1	0.5	0.10	0.03	17	92	6	2	1.3
Bmk	10-26	8.0	Tr	0.03	10.1	-	-	-	-	-	-	0	1	5	1	0.0	0.06	0.00	57	97	2	1	1.6
Ck	26-46	8.1	0.0	0.01	13.6	-	-	-	-	-	-	0	1	3	1	0.0	0.04	0.00	50	91	9	0	1.6
Ck	46-62	8.1	0.0	0.01	18.6	-	-	-	-	-	-	0	1	5	2	0.5	0.08	0.00	64	90	8	1	1.6
Site 11 -- Brunisolic Static Cryosol in beach material (Bd 1) -- representative of map unit 12:																							
Ahk	0-8	7.1	8.4	0.81	1.9	-	59.0	18.9	0.1	0.1	66.7	9	0	34	7	3.2	0.22	0.07	45	78	8	14	0.7
Bmk	8-23	7.7	1.4	0.10	11.7	-	-	-	-	-	-	1	0	10	1	2.3	0.10	0.02	51	86	9	5	1.4
Ck	23-61	7.8	0.0	0.02	20.2	-	-	-	-	-	-	1	2	7	3	1.0	0.07	0.00	56	86	12	2	1.7
Site 8 -- Lithic Regosolic Static Cryosol in residual material (Rc 2) -- representing subdominant soils of map unit 83:																							
FH	5-0	6.2	24.0	1.64	-	17.8	69.5	21.1	0.1	0.7	102.4	23	5	217	23	5.4	0.52	0.07	-	-	-	-	-
Ah_1	0-5	6.9	1.5	0.12	-	-	7.1	2.9	Tr	0.1	9.7	2	2	24	3	2.0	0.25	0.09	<20*	73	21	6	-
Ah_2	5-31	7.4	4.1	0.27	1.8	-	21.3	7.4	0.1	0.1	23.5	2	1	23	5	2.6	0.39	0.14	>50*	60	28	12	-

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* Visual estimate (% by volume)

Cryosols. The first three pedons in Table 11 (Site 39, raised beach site - Plot 8A, and Site 11) represent a continuum of increasing horizon differentiation from rapidly to moderately well drained conditions in similar parent materials (Bd 1). The last individual (Site 8) occurs in a weakly calcareous substrate.

All have Ah horizons in which partially humified organic material appears to be disassociated from mineral grains. Oxalate extractable Fe contents vary according to variations in organic carbon contents which indicates that iron is complexed and mobilized with organic compounds. The Lithic Regosolic Static Cryosol (Site 8) shows appreciable organic matter accumulation, yet is about the same age as the other profiles. Being located, however, in a microclimatically favorable position relative to most other soils of the study area, organic matter incorporation and formation of humus in mineral soil is probably comparatively rapid for such latitudes.

$CaCO_3$ data for the first three (raised beach) profiles, being from raised beaches of the same age and in the same vicinity, indicate that carbonate translocation is operating. Low evaporation rates and highly permeable materials allow rapid and deep penetration of precipitation and meltwater. A number of Regosolic Static Cryosols in raised beach crest positions displayed carbonate crusts on the undersides of large coarse fragments well into C horizons. In conjunction with carbonate removal and increased organic matter accumulation, largely reflecting increased and differing vegetative cover, reactions of surface horizons approach neutrality.

A trend of decreasing carbonate content with increasing age of raised beach occurs across the Lowland. However, profile morphologies

and pH values remain fairly constant. Since the chronosequence of raised beach materials display somewhat variable characteristics, the magnitude of this leaching trend (as suggested by $CaCO_3$ data) can only be partially attributed to pedogenic weathering.

Based on micromorphological studies of similar soils from the Truelove Lowland, Pawluk and Brewer (1975) found little evidence of chemical weathering or faunal activity as pedogenic factors. Fabrics attributable to freeze-thaw cycles dominated the profiles investigated. B horizons were described as incipient. Bmk horizon colors are probably ascribable to organic matter staining (Mikhaylov 1961) that signifies either organic matter mobility or freeze-thaw mixing or both. The highly calcareous parent materials tend to inhibit chemical weathering.

Map Units With Gleysolic Static and Fibric Organo Cryosols

Over 50% of sedge-moss dominated meadows (41% of the Lowland) are relatively unaffected by patterned ground processes other than infrequent ice-wedge fissure formation (Bliss 1975b, Muc and Bliss 1976). Five of the six soil map units (see map legend) described in this section encompass these poorly and very poorly drained meadows. Map units 31 (the largest in area) and 71 incorporate a complex of Gleysolic Static Cryosols in undifferentiated materials and Fibric Organo Cryosols in wet peat. Map units 32, 33, and 34 identify Gleysolic Static Cryosols in alluvial-lacustrine, alluvial, and till deposits, respectively. Also included is a description of map unit 72 -- Glacic Fibric Organo Cryosols of ice-cored, ice-wedge polygons (0.5% of the Lowland; Muc and Bliss 1976).

Map Units 31 and 71

Gleysolic Static Cryosols in undifferentiated material (Un) and

Fibric Organo Cryosols in fibrous organic material (wet) constitute a complex soil cover over much of the wet portions of the Truelove Lowland. These soils, occuring under hummocky and wet sedge-moss meadow communities, are represented by two map units; 31, in which Gleysolic Static Cryosols are dominant, and 71, in which Fibric Organo Cryosols are dominant.

Average maximum thaw depths of 0.3 to 0.4 m are common for Gleysolic Static Cryosols (Table 12, Plate 13) of these map units. The type pedon has a surface layer of fibrous, commonly minerotrophic, organic material that occupies 1/4 to 1/2 (excluding thickness of moss layers) of the active layer thickness. However, it is differences in peat layer thickness that account for much of the variability away from the characteristic, conceptual pedon. The mineral portions of these soils are characterized by sandy loam textures, mildly to moderately alkaline reactions, and moderate to very strong calcareousness. Very infrequently finer textures (loam to silt loam) occur under slightly drier conditions adjacent to some rock outcrops and coarser textures (well sorted sand and loamy sand) in what may be alluvial or alluvial-modified deposits near Three Rock Point (see Fig. 1). Dull or bluish colors indicative of gleying and commonly associated with reducing conditions are seldom found in the mineral portions of these soils.

Fibric Organo Cryosols (Plate 14) developed in fibrous, minerotrophic peat, exhibit average maximum thaw depths of between 0.2 and 0.3 m. Maximum and average thicknesses of peat were not investigated. However, since the two soils of map units 31 and 71 represent a continuum, it must be assumed that this property is variable across the map units. Other variations inherent in Fibric Organic Cryosols include color of peat (very dark brown and dark reddish brown) and reaction. Most common are the slightly acid to neutral Fibric Organo Cryosols (Table 13) but very strongly to medium

acid members (Table 14), normally associated with some stream-side habitats, also occur.

Table 12. A Gleysolic Static Cryosol (Histic Pergelic Cryaquept), from sampling site 6 (see Fig. 2), considered representative of mineral soils in map units 31 and 71.

Sampling Date: July 27, 1971

Approximate Elevation and Age: 10 M AMSL; <5700 years B.P.

Slope Class and Aspect: B;W

Drainage Class: Very poorly drained

Landform and Parent Material: Undifferentiated plain; undifferentiated (Un) material

Vegetation: Hummocky sedge-moss meadow (Muc and Bliss 1976)

	28-23 cm; moss layer
Of	23-0 cm; black (10 YR 2/1 m) fibrous organic matter; abundant, very fine vertical roots; abrupt, wavy boundary; 18 to 28 cm thick; pH 6.2.
Ckg	0-5 cm; dark gray to gray (2.5 Y 4.5/0 m) sandy loam; slightly sticky, non-plastic; few very fine and fine roots; abrupt, smooth boundary; 2 to 8 cm thick; pH 7.6.
Cz	5 plus cm; frozen mineral soil.

Remarks: Much variation in thickness of the Of horizon is due to hummock versus depression microtopography. Thickness of peat (Of horizon) in this soil individual does not represent the modal condition for Gleysolic Static Cryosols of map units 31 and 71 as it is 10 to 15 cm too thick.

Table 13. A Fibric Organo Cryosol (Pergelic Cryofibrist), from the intensive meadow site - Plot 6I (see Fig. 1), considered representative of organic soils in map units 31 and 71.

Sampling Date: August 17, 1971

Approximate Elevation and Age: 35 m AMSL; <8000 B.P.

Slope Class and Aspect: B-C; W

Drainage Class: Very poorly drained

Parent Material: Slightly decomposed sedges and mosses

Vegetation: Hummocky sedge-moss meadow (Muc and Bliss 1976)

2-0 cm; moss layer

Of_1 0-8 cm; very dark brown (10 YR 2/2 m) slightly decomposed organic matter; abundant, very fine and fine random roots; abrupt, smooth boundary; 8 ± 2 cm thick; slightly acid.

Of_2 8-31 cm; dark reddish brown (5 YR 2/2 m) slightly decomposed organic matter; abundant, very fine and fine random roots; abrupt, smooth boundary; 23 ± 2 cm thick; slightly acid.

Oz 31 plus cm; frozen organic material.

Remarks: The Of_1 and Of_2 horizons are separated entirely on the basis of color.

Table 14. A Fibric Organo Cryosol (Pergelic Cryofibrist), from sampling site 9 (see Fig. 2), considered representative of common organic soil variants in map units 31 and 71.

Sampling Date: July 29, 1971

Approximate Elevation and Age: 11 m AMSL; 6000 years B.P.

Slope Class and Aspect: A-B; S

Drainage Class: Very poorly drained

Parent Material: Slightly decomposed sedges and mosses.

Vegetation: Wet sedge-moss meadow (Muc and Bliss 1976).

5-0 cm; moss layer.

Of 0-18 cm; black to very dark brown (10 YR 2/1 - 2/2 m) slightly decomposed organic matter, abundant, very fine and fine random roots; abrupt, smooth boundary; 18 ± 3 cm thick; very strongly to medium acid.

Oz 18 plus cm; frozen organic material.

Remarks: This small meadow occupies a narrow swale between two raised beaches. A stream flows through its center and most of the meadow is generally under 2 to 5 cm of water throughout the summer.

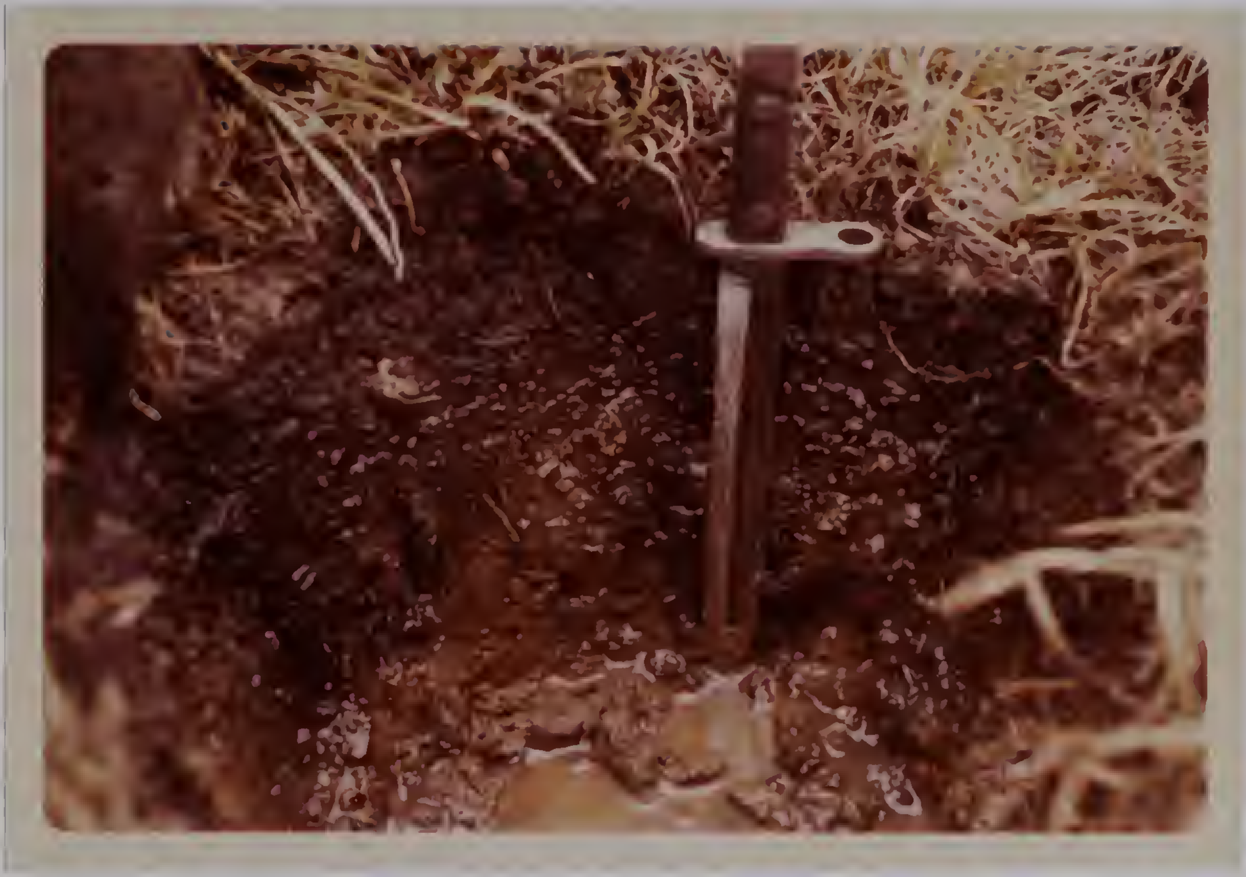

Plate 13. Gleysolic Static Cryosol (Site 24) of map units 31 and 71. The knife blade (25 cm long) is resting on permafrost.

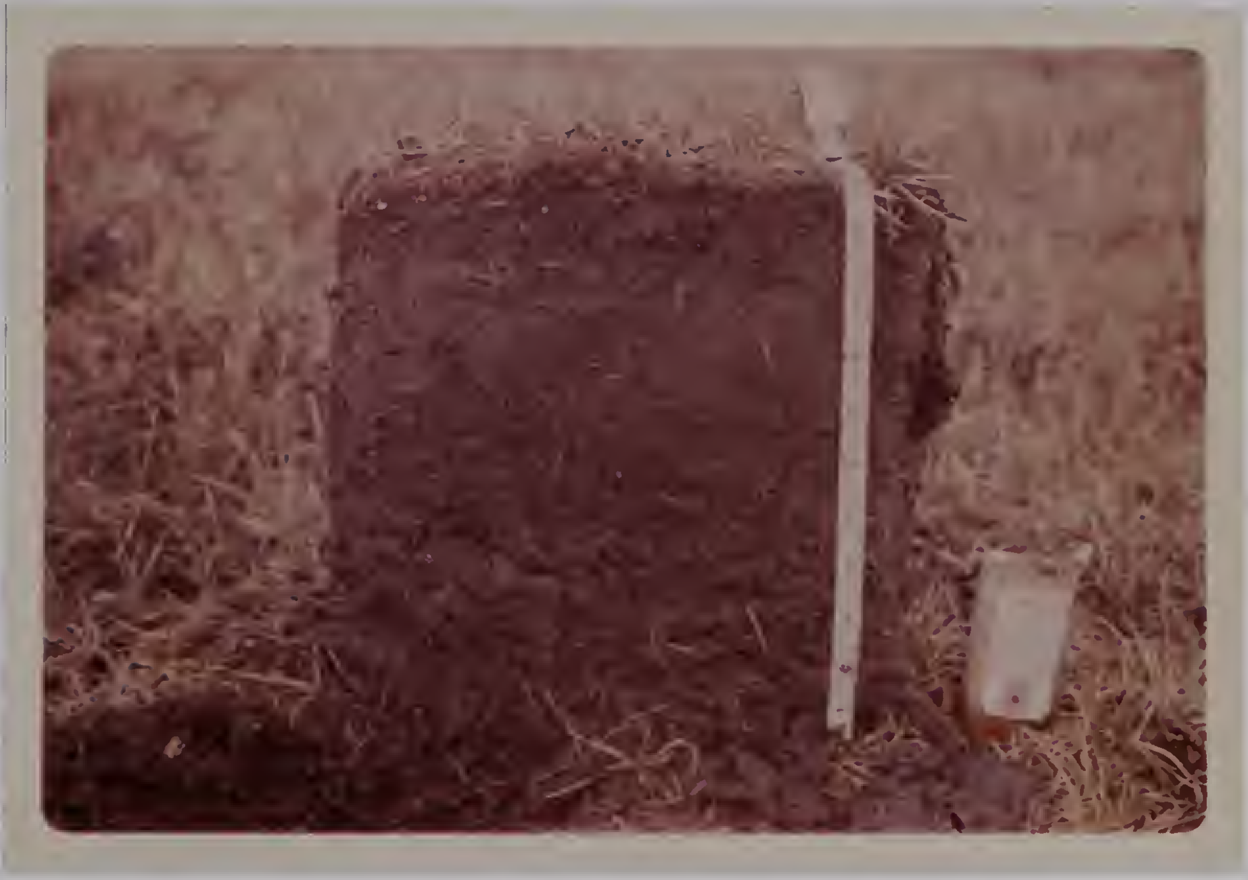

Plate 14. Fibric Organo Cryosol (Meadow site - Plot 6I) of map units 31 and 71. Reddish color of lower portion dissappears on exposed surfaces.

Map Unit 32

Flat to undulating alluvial-lacustrine plains dominated by Gleysolic Static Cryosols and hummocky to wet sedge-moss meadows belong to soil map unit 32.

The type pedon (Table 15) is characterized by a surface organic horizon, with properties analogous to peat of the organic soils and Gleysolic Static Cryosols of map units 31 and 71 (see above discussion), overlying organo-mineral horizons thought to be accretionary (deposition of mineral material on mats of vegetation) rather than pedogenic. Average maximum thaw in these soils is estimated at between 0.2 and 0.3 m.

Color, texture, organic matter content, reaction, and $CaCO_3$ content of the organo-mineral horizon, designated as "Ahg" in most cases, account for most of the variation in the soils of map unit 32. Grayish brown to very dark grayish brown moist colors dominate but dark gray and black colors may be seen on occasion. Textures range from sandy loam to clay but clay loam and silty clay textures predominate. Organic carbon, ranging from 3.1 to 11.1% in the Ahg horizons of the sampled profiles, varies among sites and within profiles. $CaCO_3$ content and pH show significant variation among sampling sites only. Medium acid to neutral and non-calcareous conditions prevail but, on occasion, weakly calcareous, mildly alkaline Ahg horizons occur. Areas adjacent to the escarpment show trends towards higher calcareous and reaction classes than areas farther away.

Map units 31, 32, and 71 have nearly identical plant communities and drainage features and occupy similar, often contiguous positions in the Lowland landscape. Soils of these units interfinger along designated soil boundaries and, consequently, add to map unit diversity.

Table 15. A Gleysolic Static Cryosol (Histic Pergelic Cryaquept), from sampling site 22 (see Fig. 2), considered representative of soils in map unit 32.

Sampling Date: July 31, 1972

Approximate Elevation and Age: 25 m AMSL; 7500 years B.P.

Slope Class and Aspect: A; level

Drainage Class: Very poorly drained

Landform and Parent Material: Alluvial-lacustrine plain; alluvial-lacustrine (As) material

Vegetation: Wet sedge-moss meadow (Muc and Bliss 1976)

14-8 cm; moss layer.

Of 8-0 cm; dark reddish brown (5 YR 2/2 m) with bands and patches of very dark brown (10 YR 2/2 m) slightly decomposed organic matter; abundant, very fine to medium random roots; abrupt, smooth boundary; 8 ± 2 cm thick; slightly acid.

Ahg 0-5 cm; grayish brown (2.5 Y 5/2 m) silty clay; amorphous; sticky, plastic; plentiful very fine and fine roots; abrupt, smooth boundary; 5 ± 2 cm thick; medium acid.

Ahz 5 plus cm; frozen organo-mineral soil.

Remarks: Although this profile is very shallow, it must be pointed out that the summer of 1972 was abnormally cool and that this site was examined relatively early in the summer (probably three to four weeks prior to maximum thaw). Similar soils exist under the more commonly occurring hummocky sedge-moss meadow vegetation.

Map Unit 33

In localized floodplains alluvium (Av 1) has been and continues to be deposited over other surficial materials. The poorly drained soils (Gleysolic Static Cryosols; Table 16, Plate 15) of these small, melt-water discharge slopes lack surface organic horizons that are characteristic of other Gleysolic Static Cryosols (see discussion for map units 31 and 71).

Significant variation in map unit 33 involves depth of alluvium. During the survey, alluvium thicknesses ranging from 0.1 to greater than 0.6 m (frost encountered) were observed. Parameters such as pH (7.5-8.0), texture (loam and silt loam), calcareousness (35-50% $CaCO_3$ equivalent),

and the nature of organo-mineral horizons (usually present as thin bands in these soils) vary slightly among sites.

Table 16. A Gleysolic Static Cryosol (Pergelic Cryaquept), from sampling site 13 (see Fig. 2), considered representative of soils in map unit 33.

Sampling Date: August 17, 1971

Approximate Elevation and Age: 50 - 60 m AMSL; 8000 years B.P.

Slope Class and Aspect: B-C; West

Drainage Class: Poorly drained

Parent Material: Alluvium (Av 1) overlying outwash (Ow 1).

Vegetation: Sedge-moss meadow (*Salix arctica* common)

	2-0 cm; moss layer containing trapped fine earths (SiL in texture).
Cg$_1$	0-2 cm; dark gray (2.5 Y 4/0 m) loam: sticky, slightly plastic; abundant, very fine and fine random roots; abrupt, broken boundary; 0-3 cm thick.
Ahg$_1$	2-5 cm; very dark grayish brown (10 YR 3/2 m) loam to silt loam; sticky, slightly plastic; abundant, very fine and fine random roots; abrupt, wavy boundary; 3 ± 1 cm thick.
Cg$_2$	5-11 cm; dark gray (2.5 Y 4/0 m) loam; sticky, slightly plastic abundant, very fine and fine random roots; abrupt, wavy boundary; 6 ± 1 cm thick; mildly alkaline.
Ahg$_2$	11-14 cm; very dark grayish brown (10 YR 3/2 m) loam; sticky, slightly plastic; plentiful, very fine and fine roots; abrupt, wavy boundary; 3 ± 1 cm thick.
Cg$_3$	14-18 cm; yellowish brown (10 YR 5/4 m) loam; sticky, slightly plastic; plentiful, very fine and fine roots; abrupt, smooth boundary; 2-7 cm thick; mildly alkaline.
IICg$_1$	18-56 cm; yellowish brown (10 YR 5/4 m) gravelly silty clay loam; sticky, slightly plastic; few and very few, very fine and fine roots to 51 cm; abrupt, smooth boundary; 38 ± 5 cm thick; mildly alkaline.
IICg$_2$	56 plus cm; rubble, mainly stones and cobbles, with small, infrequent pockets of yellowish brown (10 YR 5/4 m) silty clay loam alluvium.

Remarks: The Ahg horizons are not considered pedogenic but, rather, are organo-mineral horizons that mark previously existing vegetated soil surfaces. They consist of fibrous organic material and entrapped alluvium.

Map Unit 34

Map unit 34, occupying lower portions of a lateral moraine, resembles very closely map unit 31 with exception that map unit 34 lacks subdominant organic soils. Gleysolic Static Cryosols developed in till (Tm) are dominant and morphologically identical to those of map units 31 and 71. Map unit 34 is distinguished by steeper slopes and a more even distribution of subrounded stones. In addition, the parent material (Tm) tends towards slightly finer textures. Within the study area, map unit 34 occurs on the south-facing lower slope of a lateral moraine within the Truelove River Valley.

Map Unit 72

Soil map unit 72 encompasses those areas characterized by high-centered, ice-cored polygons (see landform and parent material description in Parent Material section). Glacic Fibric Organo Cryosols (Table 17, Plate 16), developed in dry fibrous peat, occupy polygon tops. Frozen peat is underlain, at variable depths, by ground ice containing bands of frozen peat with variable but fairly high contents of ice.

Significant soil variation in map unit 72 occurs in interpolygon trenches where trench walls and bottoms are inhabited by wetter, more fibrous, very shallow organic soils.

Plate 15. Gleysolic Static Cryosol (Site 13) representative of map unit 33.

Plate 16. A Glacic Fibric Organo Cryosol (Site 4) showing black organic material (derived *in situ*) overlying olive colored sedimentary peat.

Table 17. A Glacic Fibric Organo Cryosol (Pergelic Cryofibrist), from sampling site 1 (See Fig. 2), considered representative of soils in map unit 72.

Sampling Date: June 26, 1971

Approximate Elevation and Age: 8m AMSL; 2450 years B.P. (basal peat age according to Barr 1971)

Site Position: Slightly rounded top of a polygon

Drainage Class: Moderately well drained

Landform and Parent Material: High centred, ice-cored polygons; fibrous, dry peat overlying ground ice

Vegetation: Ice-wedge polygon (cushion plant) (Muc and Bliss 1976)

L 2-0 cm; moss and litter layer.

Of 0-13 cm; black to very dark brown (10 YR 2/1 - 2/2 m) slightly decomposed organic matter; quite compact; few, very fine and fine roots; abrupt, smooth boundary; 13 ± 2 cm thick; medium acid.

Oz 13-38 cm; black to very dark brown (10 YR 2/1 - 2/2 m) frozen peat with a high ice content.

Grd Ice 38-140 cm; predominantly ice containing peat layers of variable thicknesses and organic matter contents.

Cz 140 plus cm; frozen gravels and stones.

Remarks: A small diameter, hand-operated ice corer was used to describe and sample this profile to the Cz layer.

Analytical Features of Gleysolic Static and Fibric Organo Cryosols

Chemical and physical data for selected Gleysolic Static Cryosols and Fibric Organo Cryosols are presented in Tables 18 and 19, respectively.

Organic layers (22 to 43% organic carbon) of the selected profiles exhibit some rather interesting variations. Those of slightly acid reaction generally have total nitrogen contents above 2%; C/N ratios of 12-16 to 1; base saturation ranging from 60 to 100% (commonly about 90%); low available nutrient status, particularly phosphorus; and bulk densities of about 0.2 gm/cc. Very strongly to strongly acidic organic layers (Site 9) generally have total nitrogen contents below 2%; C/N ratios of 13-23

Table 18. Chemical and physical data for selected Gleysolic Static Cryosols

						Exchangeable Cations (me/100g)						Available Nutrients (ppm)					Oxalate			Particle Size Distribution (% of <2mm fraction)			
Horizon	Depth (cm)	pH	Org. Carbon %	Total N %	$CaCO_3$ Equiv. %	H	Ca	Mg	Na	K	T.E.C. (me/100g)	NO_3-N	P	K	Na	SO_4-S	Fe %	Al %	% Coarse Fragments (>2mm)	Sand (2.0 - 0.05mm)	Silt (0.05 - 0.002mm)	Clay (<0.002 mm)	Bulk Density (gm/cc)
Site 6 -- Gleysolic Static Cryosol in undifferentiated material (Un) -- representative of map units 31 and 71:																							
Of	23-0	6.2	26.1	2.24	-	13.8	49.2	15.1	0.1	0.2	75.9	0	5	105	40	50+	0.54	0.13	-	-	-	-	0.2-0.3*
Ckg	0-5	7.6	0	0.04	35.5	-	-	-	-	-	-	0	1	18	4	21.2	0.62	0.02	-	63	31	6	-
Site 22 -- Gleysolic Static Cryosol in alluvial-lacustrine material (As) -- representative of map unit 32:																							
Of	8-0	6.5	34.3	1.89	-	29.3	45.1	15.9	0.2	0.4	98.0	-	-	-	-	-	4.04	0.03	-	-	-	-	-
Ahg	0-5	5.7	5.8	0.45	-	8.5	9.9	3.7	0.1	0.2	26.7	-	-	-	-	-	0.97	0.18	-	2	43	55	-
Site 13 -- Gleysolic Static Cryosol in alluvial material (Av 1) -- representative of map unit 33:																							
Cg_2	5-11	7.5	1.0	.09	46.8	-	8.7	3.2	Tr	0.1	5.7	1	0	28	1	14.2	.31	.05	<10†	37	43	20	-
Cg_3	14-18	7.8	0.5	.07	47.3	-	-	-	-	-	-	1	0	33	1	2.3	.29	.00	<10†	36	42	22	-
$IICg_1$	18-56	7.8	1.0	.11	35.4	-	-	-	-	-	-	1	0	64	1	2.0	.28	.05	40-50†	19	50	31	-

* Estimate based on data collected from other sites

† Visual estimate (% by volume)

Table 19. Chemical and physical data for selected Fibric Organo Cryosols

Horizon	Depth (cm)	pH	Org. Carbon %	Total N %	CaCO$_3$ Equiv. %	Exchangeable Cations (me/100g) H	Exchangeable Cations (me/100g) Ca	Exchangeable Cations (me/100g) Mg	Exchangeable Cations (me/100g) Na	Exchangeable Cations (me/100g) K	T.E.C. (me/100g)	Available Nutrients (ppm) NO$_3$-N	Available Nutrients (ppm) P	Available Nutrients (ppm) K	Available Nutrients (ppm) Na	Available Nutrients (ppm) SO$_4$-S	Oxalate Fe %	Oxalate Al %	% Coarse Fragments (>2mm)	Particle Size Distribution (% of <2mm fraction) Sand (2.0 - 0.05mm)	Particle Size Distribution (% of <2mm fraction) Silt (0.05 - 0.002mm)	Particle Size Distribution (% of <2mm fraction) Clay (<0.002 mm)	Bulk Density (gm/cc)
Intensive Meadow Study Site (Plot 6I) -- Fibric Organo Cryosol in sedge-moss derived peat (wet) -- representative of map units 31 and 71:																							
Of$_1$	0-8	6.5	38.1	3.06	-	13.0	110.7	35.2	0.2	0.4	132.5	4	0	129	21	5.4	0.92	0.15	-	-	-	-	0.2*
Of$_2$	8-31	6.2	42.2	2.68	-	22.3	93.5	23.4	0.2	0.2	127.9	6	0	47	25	8.0	0.26	0.13	-	-	-	-	0.2*
Site 9 -- Fibric Organo Cryosol in sedge-moss derived peat (wet) -- variant within map units 31 and 71:																							
Of	0-3	5.9	38.7	1.69	-	24.6	31.8	4.5	0.4	0.8	83.0	5	10	393	35	6.8	11.08	0.03	-	-	-	-	0.1-0.2*
Of	3-6	5.2	40.3	1.97	-	45.7	39.8	14.0	0.2	0.6	130.6	0	10	210	35	21.2	3.34	0.05	-	-	-	-	0.1-0.2*
Of	6-9	5.0	36.4	2.01	-	54.5	21.3	0.8	0.3	0.4	104.6	0	10	108	30	46.0	2.72	0.09	-	-	-	-	0.1-0.2*
Of	9-12	4.9	22.6	1.80	-	39.6	15.3	Tr	0.0	0.1	75.8	2	5	61	23	44.0	3.14	0.13	-	-	-	-	0.1-0.2*
Of	12-15	5.0	29.1	1.85	-	45.8	19.0	4.2	0.0	0.1	79.6	0	10	78	30	38.7	2.34	0.16	-	-	-	-	0.1-0.2*
Of	15-18	5.1	30.4	1.93	-	45.9	22.8	6.9	0.0	0.2	77.6	0	10	78	35	44.0	3.20	0.18	-	-	-	-	0.1-0.2*
Site 1 -- Glacic Fibric Organo Cryosol in dry peat overlying ground ice -- representative of map unit 72:																							
Litter	2-0	6.0	34.6	2.23	-	15.8	50.1	34.7	0.8	2.2	98.1	200+	140	1335	75	14.7	-	-	-	-	-	-	-
Of$_1$	0-13	5.8	27.8	2.00	-	15.8	44.2	27.9	0.6	0.3	88.2	88	10	275	100	9.2	-	-	-	-	-	-	-
Grnd. Ice†	76-130	6.2	37.3	2.40	-	17.6	64.4	38.9	0.7	0.4	103.3	0	65	160	65	11.4	-	-	-	-	-	-	-

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* Estimate based on data collected from these and similar meadows by Muc (1975)

† Results obtained from organic fraction only and not adjusted for high ice content of sample

to 1; base saturation percentages of 20 to 45; significantly higher contents of available phosphorus and potassium; and bulk densities of about 0.15 gm/cc. Base saturation percentage decreases in Site 9 from 45 at the surface to 20 in the middle of the active layer (6-12 cm) and increases to 39 above the frost table. Site 9 also shows significant accumulation of oxalate extractable Fe, particularly in the surface 3 cm increment. These data trends suggest that organic soils of such stream-side habitats are collecting sites for some organic-complexed elements.

The available nutrient status of the Glacic Fibric Organo Cryosol (Site 1) is unusually high relative to all other soils of the study area. Although the exact significance of this trait has not been determined, it must be, in part, a reflection on the relatively warm, dry microclimate affecting these soils.

Mineral portions of most Gleysolic Static Cryosols are mildly alkaline, calcareous, base rich, and low in available nutrients. The Ahg horizon of Site 22 has a medium acid reaction and base saturation of about 50% -- features partially indicative of alluvial-lacustrine (or lagoonal) parent materials (refer to Soil Parent Materials section).

Pedogenic Trends in Gleysolic Static and Fibric Organo Cryosols

Discussion on pedogenic trends in soils of wet, non-cryoturbated habitats is based on morphologic features, habitat characteristics, and analytical data (Tables 18 and 19).

In all but one profile, littering and paludization processes (Buol *et al.* 1973) operate in continuum from Gleysolic Static Cryosols to Fibric Organo Cryosols. Based on observations across the Lowland, thickness of peat accumulation is not dependent, in the main, upon age. Theoretically, restricted lateral meltwater flow coupled with early and more dense plant

colonization (both conducive to greater littering) have produced, in shallow basins and very flat areas adjacent to lakes, greater organic accumulations than on very gentle slopes where lateral flow rates may be slightly greater.

Humification is minor in all peats but is slightly more evident in dry organic materials (Glacic Fibric Organic Cryosols) of ice-wedge polygons formed over ground ice. In essence, the quite homogenous, wet, organic material accumulated over much of the Lowland (*ca* 40%) is a fairly compacted, neutral to slightly acidic, and highly fibrous deposit. Medium to very strongly acidic deposits of stream-side micro environments, although morphologically similar, have very high oxalate-extractable iron contents probably associated with accumulation of Fe-complexed organic materials.

Gleysolic Static Cryosols of recent alluvium (Site 13) and, to a lesser extent, of alluvial-lacustrine deposits (Site 22) have morphologies indicative of cumulization (Buol *et al.* 1973). Concentration of organic material, via frost churning or migration of humic substances, in layers at or near the permafrost table, as reported for many Tundra (gley) soils (see Literature Review), was not observed in soils of the study area.

Gleization, revealed by bluish gray matrix colors with or without mottles (Buol *et al.* 1973), is very weakly expressed in all Gleysolic subgroups of the study area. Comparatively pronounced gley colors were occasionally found in thin bands immediately below organic layers or in rarely occurring sorted, medium to coarse sands. This may reflect the high Fe contents plus some microbial activity associated with overlying peat layers. Generally, however, the paucity of gley manifestations probably reflects low populations and kinds of microorganisms (in particular, iron reducing bacteria).

Map Units With Turbic Cryosols

Frost-disturbed soils with circle, net, and stripe surface expressions form the map units (see map legend) described in this section. Generally, such soils form in habitats of intermediate moisture status (moderately well to poorly drained soil conditions). Subgroup classes include Brunisolic (map units 41 and 42), Regosolic (map units 42 and 51), and Gleysolic (map units 61 and 62). Parent materials include beach deposits (map units 41 and 42), till of the Lowland (map unit 51), undifferentiated material (map unit 61), and till of the upland (map unit 62).

Map unit descriptions are based on cyclic pedons (Soil Survey Staff 1960)--one cyclic pedon (from frost-boil center to trough center) forming one soil individual.

Map Unit 41

Relatively small raised beaches, forming slightly elevated, convex-shaped landforms in otherwise flat terrain and characterized by patterned ground features and cushion plant-moss (frost-boil) plant community (Plate 17) belong to map unit 41. Imperfectly drained Brunisolic Turbic Cryosols (Table 20; Fig. 9; Plate 18), characteristic of this map unit, show considerable variability because of physical deformation and the unusual width of pedons--from sparsely vegetated frost-boil (or hummock) center to densely vegetated trough center, a distance ranging from 1 to 2 m. Morphologically, A-B horizon sequences usually occur, either vertically or obliquely, to frost under trough positions while hummocks, covering about 40% of the map unit, consist of C horizon (Fig. 9). Due to the confining microtopography, A horizons of troughs are usually organic (greater than 17% organic C). B horizons display considerable variability, ranging from

Table 20. A Brunisolic Turbic Cryosol (Pergelic Cryochrept), from sampling site 34 (see Fig. 2), considered representative of soils in map unit 41.

Sampling Date: August 16, 1972

Approximate Elevation and Age: 65 m AMSL; 8900 years B.P.

Slope Class and Aspect: A-B; West

Drainage Class: Imperfectly drained

Landform and Parent Material: Raised beach; Bd 1 beach material

Vegetation: Cushion plant-moss with frost boils (Muc and Bliss 1976)

LFH	2-0 cm; slightly to well decomposed litter occurring beneath cushion plants and mosses; 0 to 3 cm thick.
$Ahky_1$	0-36 cm; black (10 YR 2/1 m) gravelly loamy sand (very high organic matter content); amorphous; very friable; plentiful, very fine and fine oblique and horizontal roots; estimated coarse fragments 40% (cobbles and stones concentrated near lower boundary); abrupt, broken boundary; 0 to 41 cm thick; mildly alkaline.
$Bmky_1$	20-29 cm, dark brown (10 YR 3/3 m) loamy sand; single grain; friable; few, very fine and fine roots; abrupt, broken boundary; 0 to 10 cm thick; moderately alkaline.
$Bmky_2$	20-24 cm; strong brown (7.5 YR 5/6 m) loamy sand; single grain; friable; very few, very fine and fine roots; clear, broken boundary; 0 to 5 cm thick; moderately alkaline.
Cky	0-56 cm; yellowish brown (10 YR 5/4 m) sandy loam; common, medium faint yellowish brown (10 YR 5/6 m) and dark yellowish brown (10 YR 4/4 m) mottles; friable; very few, micro and very fine roots to 25 cm; abrupt, broken boundary; 0 to 56 cm thick; moderately alkaline.
Cz	56 plus cm; frozen beach material; upper boundary at 45 to 56 cm from mineral soil surface.

Remarks: According to criteria specified in Canadian soil taxonomy (C.S.S.C. 1970) the $Ahky_1$ horizon is borderline between mineral and organic horizons. The typical pedon representing map unit 41 would have an FH or H horizon replacing the $Ahky_1$ horizon of this soil individual because surface organic horizons in trough positions are more prevalent. See Fig. 9 for diagrammatic representation of this profile.

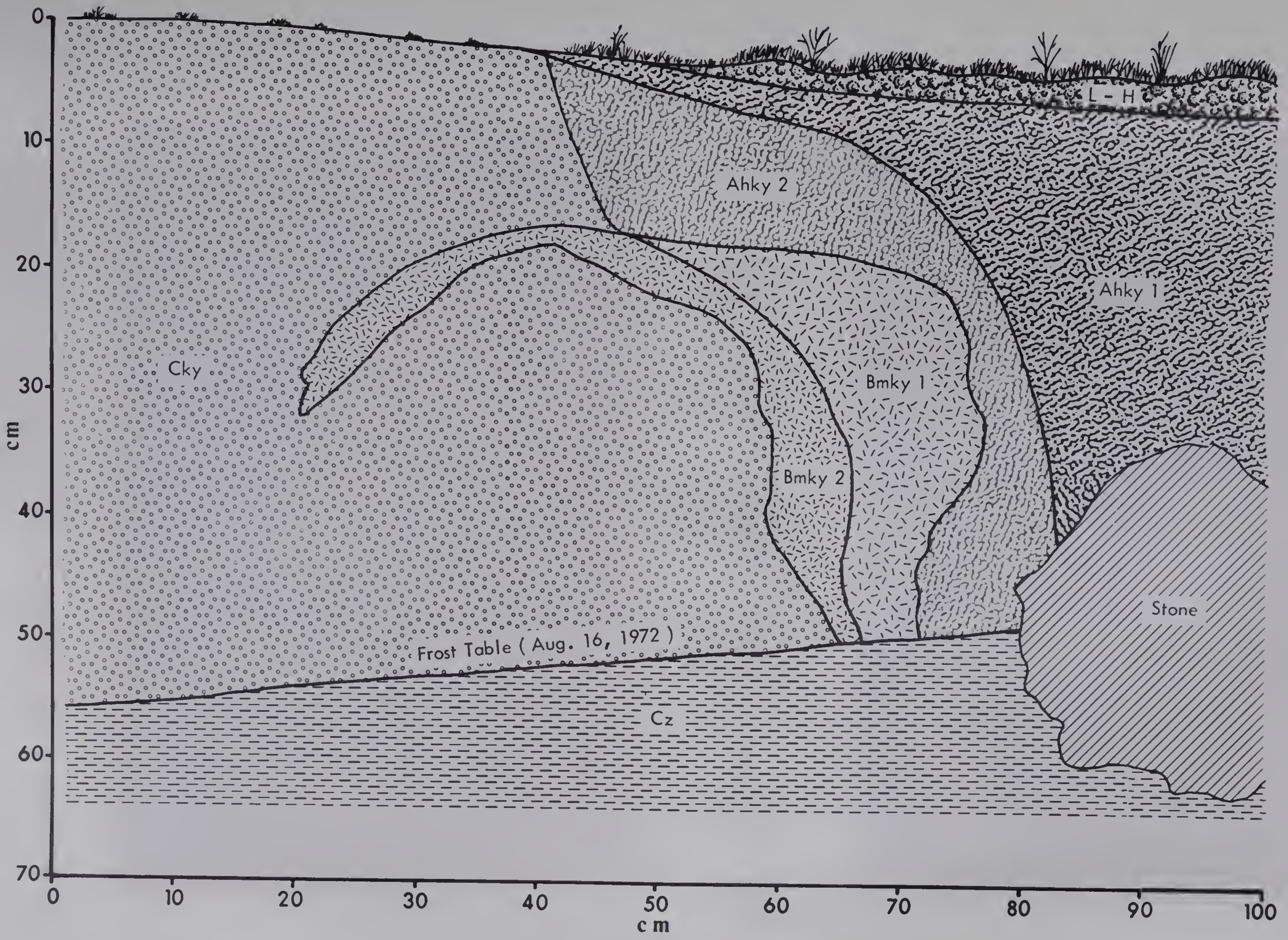

Figure 9. Diagrammatic cross-section of a Brunisolic Turbic Cryosol (based on Site 34) representative of soils in map unit 41.

Plate 17. A gently sloping area belonging to map unit 41. Cushion plant-moss vegetation with frost-boils (circles and nets) is typical.

Plate 18. A Brunisolic Turbic Cryosol (Site 34) representative of soils in map unit 41.

weakly developed cones that display only slight humus accumulation and chemical alteration to those that may have received small amounts of mobile iron, based on color and oxalate-extractable Fe data. Texturally, the soils of map unit 41 range from loamy sands to loams. Coarse fragments are not as abundant as in beach material (Bd 1) of more prominent raised beaches (map units 11, 12 and 21) but cobbles and stones are more frequent under trough positions indicating some degree of sorting by cryoturbation processes.

Noted as inclusions in map unit 41 are those areas no longer undergoing active physical disruption (cryoturbation). In such situations, hummocks have recently become vegetated and, in many cases, normal (vertical) horizon development is as yet imperceptible.

Map Unit 42

Soil map unit 42 is associated with moderately to strongly sloping, stony beach (Bd 1) material and is dominated by imperfectly drained Brunisolic Turbic Cryosols and Regosolic Turbic Cryosols. Stripes (Washburn 1956) are the prevailing patterned ground feature. The Brunisolic Turbic Cryosols resemble those of map unit 41. Regosolic Static Cryosols lack B horizons under trough positions. These soils are probably less stable than those of map unit 41 due to greater slope gradients and stoniness.

Map Unit 51

Soil map unit 51 is associated with moderately to strongly sloping, very stony till (Tm), usually sandy loam in texture, and is dominated by imperfectly to moderately well drained Regosolic Turbic (Plate 19) and Brunisolic Turbic Cryosols. Very intense sorting during formation of striped patterned ground has, in many cases, resulted in sparsely vegetated

troughs that are dominated by stones. Unstable conditions plus the lack of vegetation have produced weakly developed soils. Some elevated positions labelled as map unit 51 (Wolf Hill, Fig. 1) become quite dry during late summer.

Map Unit 61

Map unit 61 occupies a large part of undifferentiated plains and is commonly associated with map units 31 and 71 with respect to topographic position and drainage. Gleysolic Turbic Cryosols (Table 21; Fig. 10) are dominant and develop under a frost-boil sedge-moss meadow community (Plate 20). All patterned ground types (circles, nets, and stripes) are found in this map unit with stripes frequenting the steeper sloping areas.

Gleysolic Turbic Cryosols exhibit much less variability than Brunisolic Turbic Cryosols (see discussion under map unit 41) considering that pedon widths are about the same for both taxonomic types. Various degrees of sorting, manifest within profiles by concentration of gravels and cobbles below organic layers (Fig.10), take place in Gleyosolic Turbic Cryosols. Organic layer thicknesses are somewhat variable as are textures, ranging from loamy sand to loam (sandy loam is dominant).

As with Gleysolic Static Cryosols in undifferentiated material, soils of map unit 61 do not exhibit strong gley coloration. Some profiles have, at the mineral soil surface, thin bands of grayish colored mineral soil (1 cm thick in frost boil positions but thickening to 5-10 cm under organic layers). Their position may reflect an input of humic material plus warmer temperatures thereby increasing microbial activity.

Map unit 61 also indicates, on the map, infrequently occurring alluvial-lacustrine (As) areas that have patterned ground (circles and nets). Gleysolic Turbic Cryosols of such areas (shown as complexes of map units

32 and 61) have textures and reactions similar to Gleysolic Static Cryosols of map unit 32.

Table 21. A Gleysolic Turbic Cryosol (Ruptic-Histic Pergelic Cryaquept), from sampling site 35 (see Fig. 2), considered representative of soils in map unit 61.

Sampling Date: August 16, 1972

Approximate Elevation and Age: 25 m AMSL; 7300 years B.P.

Slope Class and Aspect: A; level

Drainage Class: Very poorly to poorly drained

Landform and Parent Material: Undifferentiated plain; undifferentiated (Un) material

Vegetation: Frost-boil sedge-moss meadow (Muc and Bliss 1976)

	3-0 cm; moss layer; 0 to 4 cm thick.
Ofy	18-0 cm; black to very dark brown (10 YR 2/1 - 2/2 m) slightly decomposed organic matter; plentiful fine vertical roots; some cobbles at lower boundary; abrupt, broken boundary; 0 to 18 cm thick; neutral.
Ckg	0-40 cm; light olive brown (2.5 Y 5/4 m) sandy loam; thin band of olive gray (5 Y 4.2 m) sandy loam beneath Ofy horizon; slightly sticky, nonplastic; contains some gravels and cobbles; abrupt, smooth boundary; 35 to 43 cm thick; moderately alkaline.
Ckgy	0-51 cm; light olive brown (2.5 Y 5/4 m) sandy loam; very thin band of olive gray (5 Y 4/2 m) sandy loam at the surface; slightly sticky, non plastic; abrupt, smooth boundary; 48 to 51 cm thick; moderately alkaline.
Cz	51 plus cm; frozen mineral soil; frost at 35 to 51 cm below mineral soil surface.

Remarks: Refer to Fig. 10 for a diagrammatic representation of this profile. It is assumed that mineral material underlying the organic layer (Of horizon) is not frost-churned and is therefore labelled Ckg. Material forming the frost-boil is assumed to be churned and heaved and is therefore labelled Ckgy. However, boundaries separating these two horizons cannot be seen in any Gleysolic Turbic Cryosols. It is assumed that a diffuse boundary does exist but its shape and position are not known. A slight increase in coarse fragment content of the Ckg horizon relative to the Ckgy horizon indicates some degree of sorting. The frost-boil is vegetated by sporadically occuring sedges and algae.

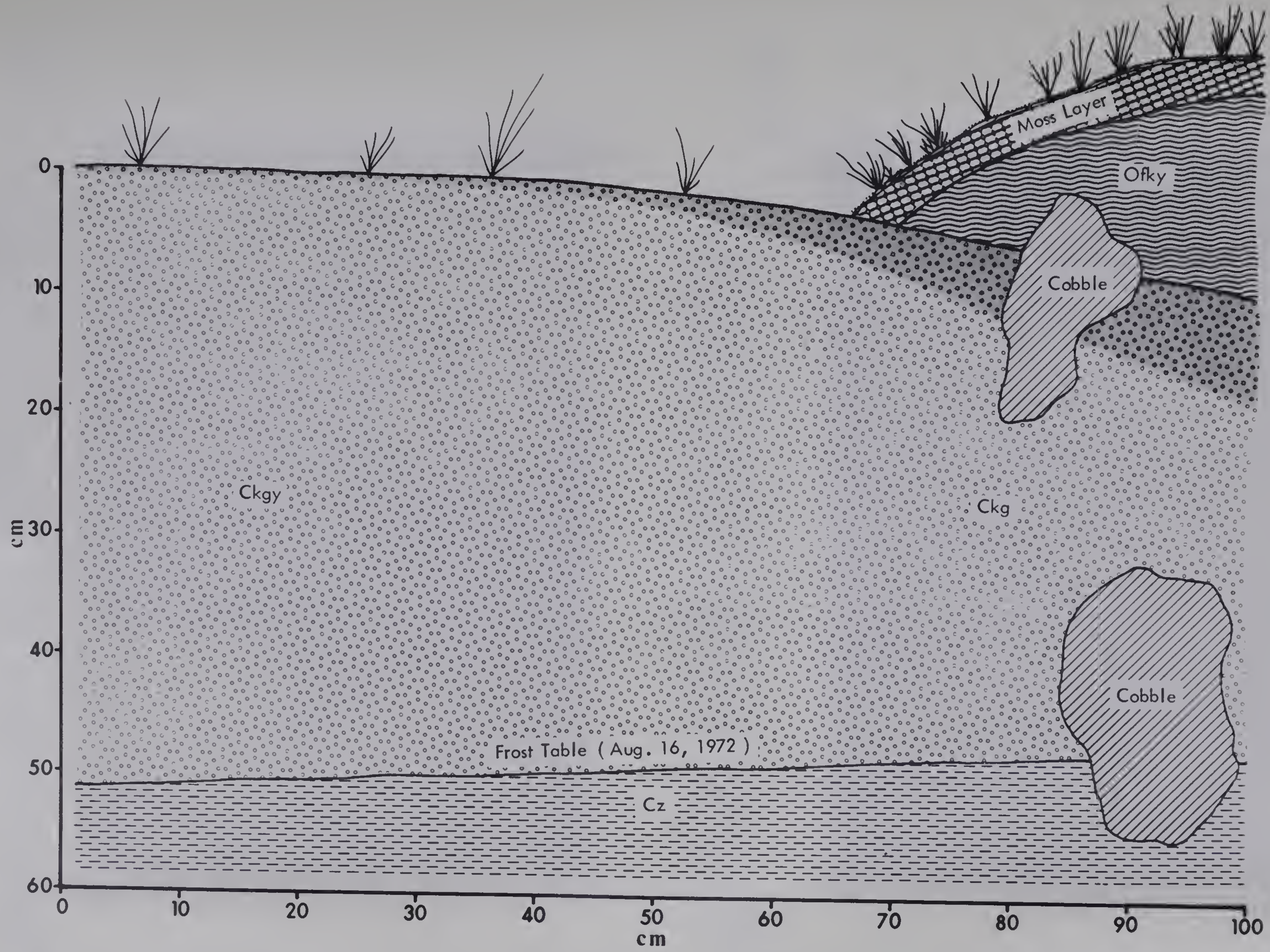

Figure 10. Diagrammatic cross-section of a Gleysolic Turbic Cryosol (based on Site 35) representative of soils in map unit 61.

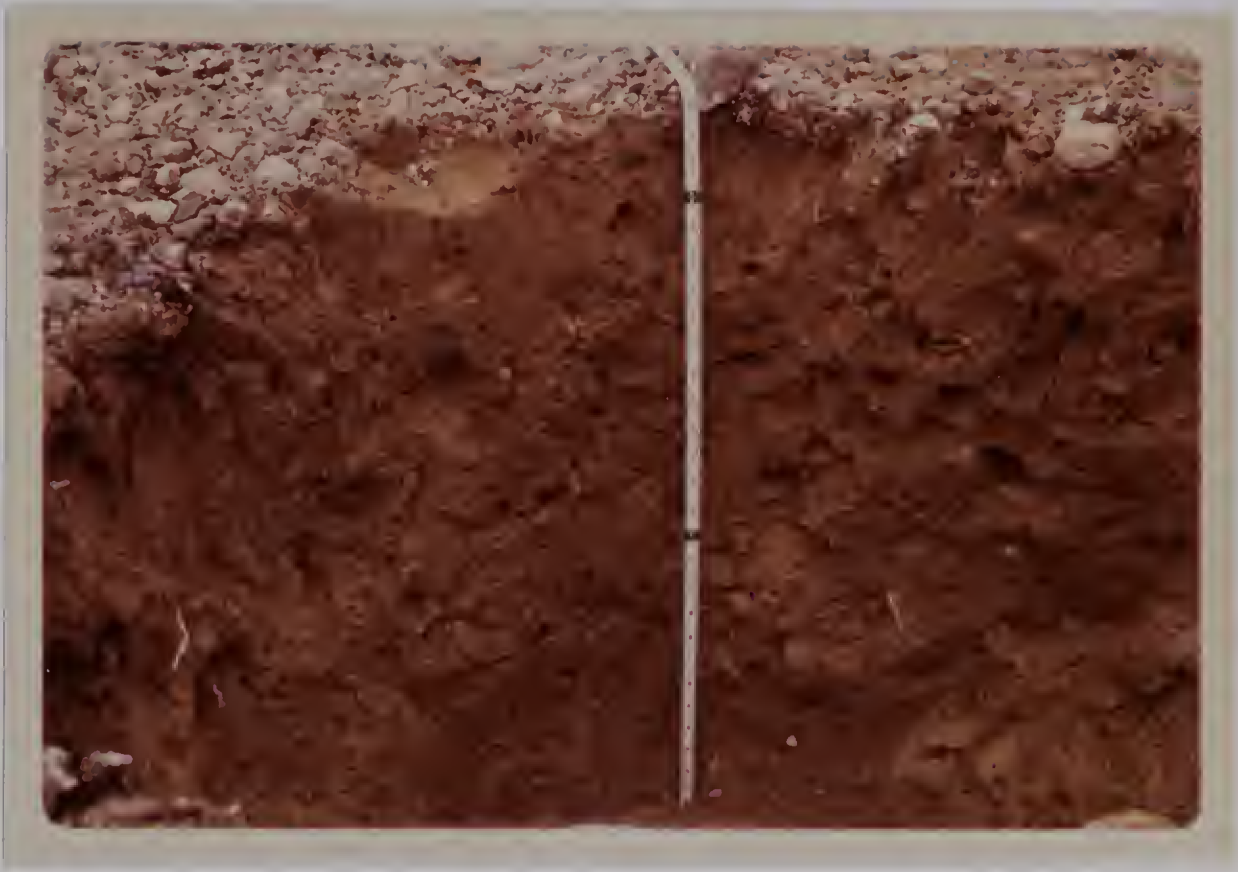

Plate 19. A Regosolic Turbic Cryosol developed in calcareous, sandy loam till (Tm). The trough position with an Ahky horizon is on the extreme left of the photograph. This profile is drier and much less stony than most in map unit 51.

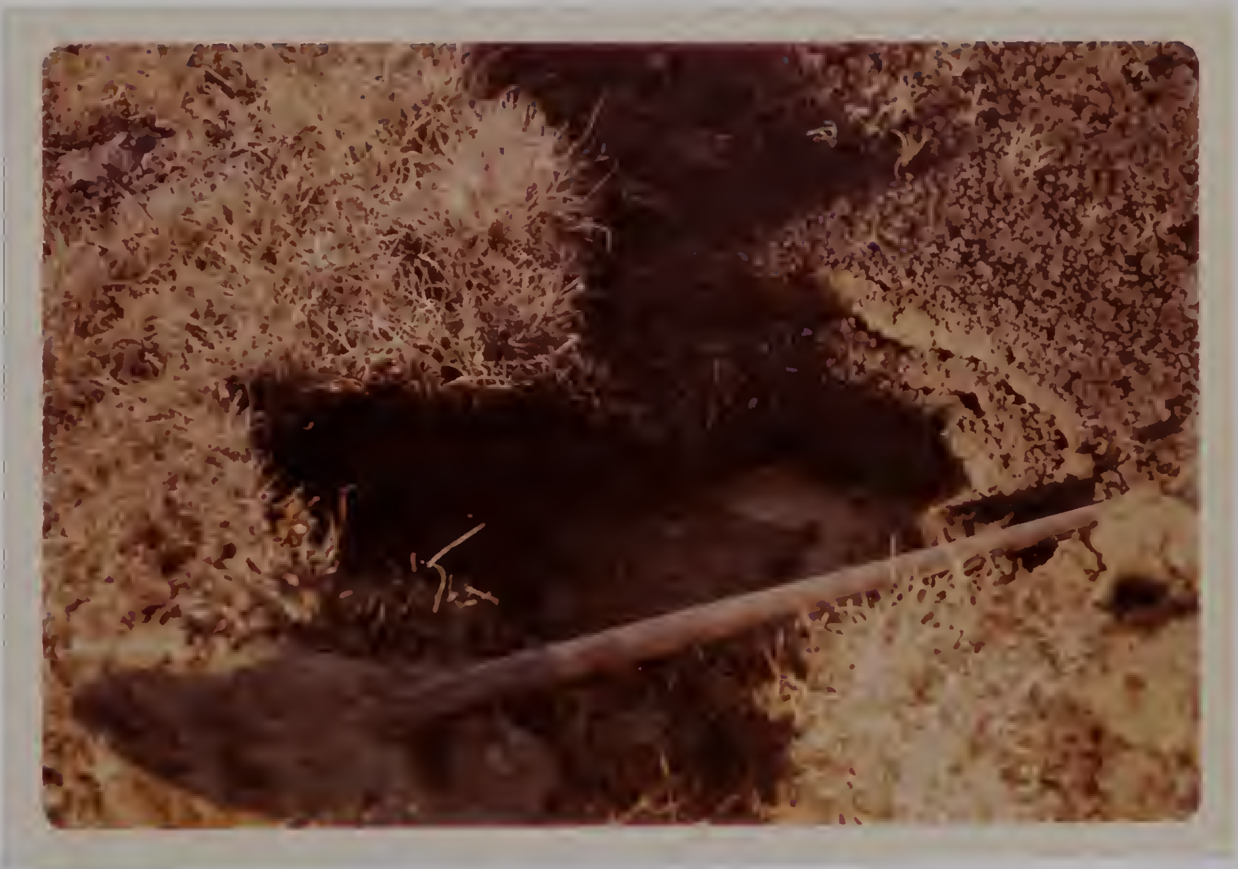

Plate 20. A Gleysolic Turbic Cryosol (Site 35) representative of soils in map unit 61. Vegetation is identified as frost-boil sedge-moss meadow community.

Map Unit 62

Gleysolic Turbic Cryosols (Table 22, Plate 21) dominate the plateau portion of the study area. These soils, developed in fine-textured, calcareous till (Tm) of an extensive ground moraine, lack the surface organic layers of their Lowland counterparts. Duller colors and more intense mechanical sorting of gravels are also characteristic features. Striped ground (Plate 22) is the most common manifestation of cryoturbation with stripes being aligned downslope and parallel to the direction of groundwater flow, thus indicating a certain amount of gelifluction or mass flow.

Table 22. A Gleysolic Turbic Cryosol (Pergelic Cryaquept), from sampling site 29 (see Fig. 2), considered representative of soils in map unit 62.

Sampling Date: August 11, 1972

Approximate Elevation: 330 m AMSL

Slope Class and Aspect: C; W

Drainage Class: Poorly drained

Landform and Parent Material: Ground moraine; glacial till (Tg)

Vegetation: Moss-herb (Polar Desert) (Muc and Bliss 1976)

Ckgy$_1$ 0-21 cm; olive (5 Y 5/3 m) silt loam; very sticky, plastic; gradual, smooth boundary; 18 to 25 cm thick; mildly alkaline.

Ckgy$_2$ 21-36 cm; pale olive (5 Y 6/3 m) silty clay loam to clay loam; very sticky, plastic; abrupt, smooth boundary; 15 ± 3 cm thick; mildly alkaline.

Ckgy$_3$ 0-10 cm; olive (5 Y 5/3 m) gravelly silt loam; very sticky, plastic; clear, broken boundary; 0 to 15 cm thick.

Cz 36 plus cm; frozen mineral soil.

Remarks: The Ckgy$_3$ horizon represents a cross-section of a vegetation-stone stripe (wedge or V-shaped in cross-section) that is oriented parallel to the slope. Separation was based on coarse fragment content which decreases with depth in the Ckgy$_3$ horizon but, in terms of the whole profile, indicates that mechanical sorting has taken place. These stripes, ranging from 5 to 15 cm in surface width, are depressed up to 5 cm below the centers of the slightly convex frost boils.

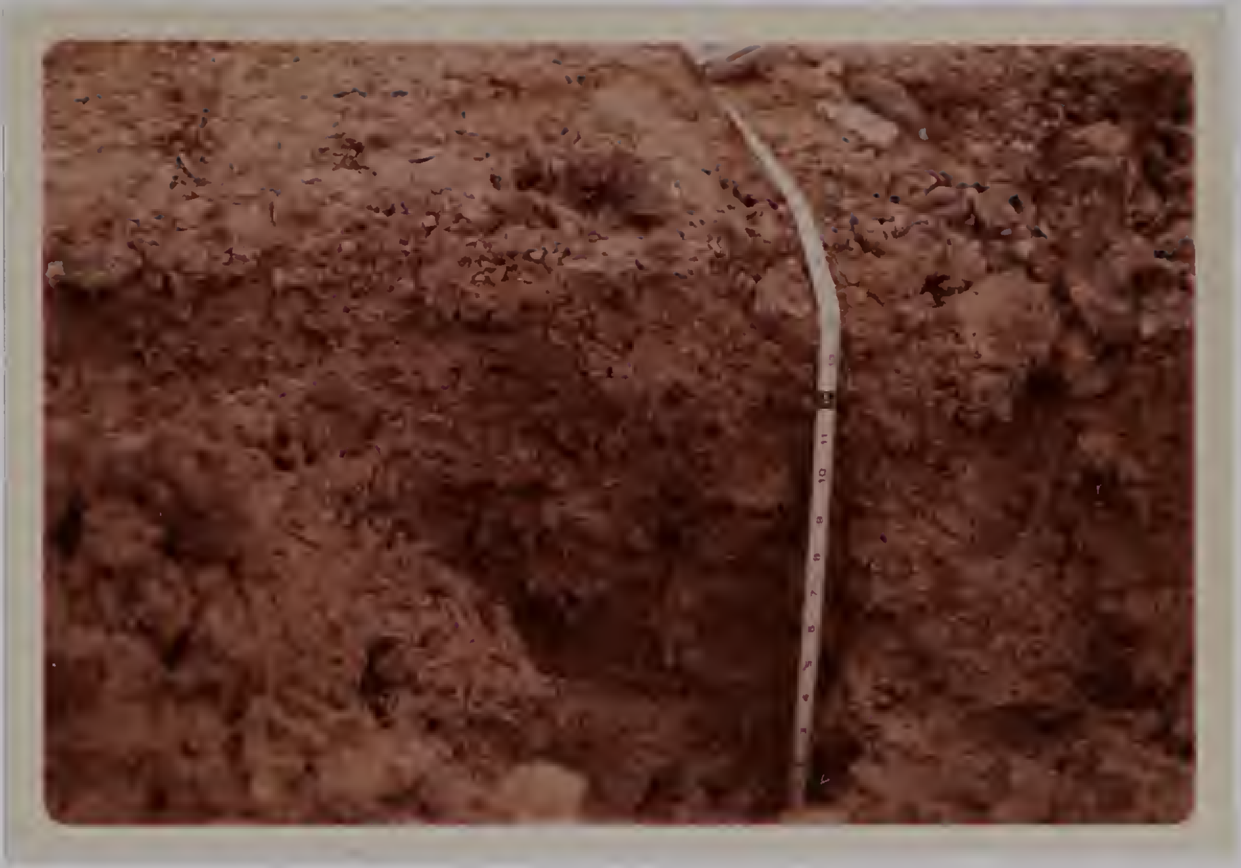

Plate 21. A Gleysolic Turbic Cryosol (Site 29) representative of soils in map unit 62.

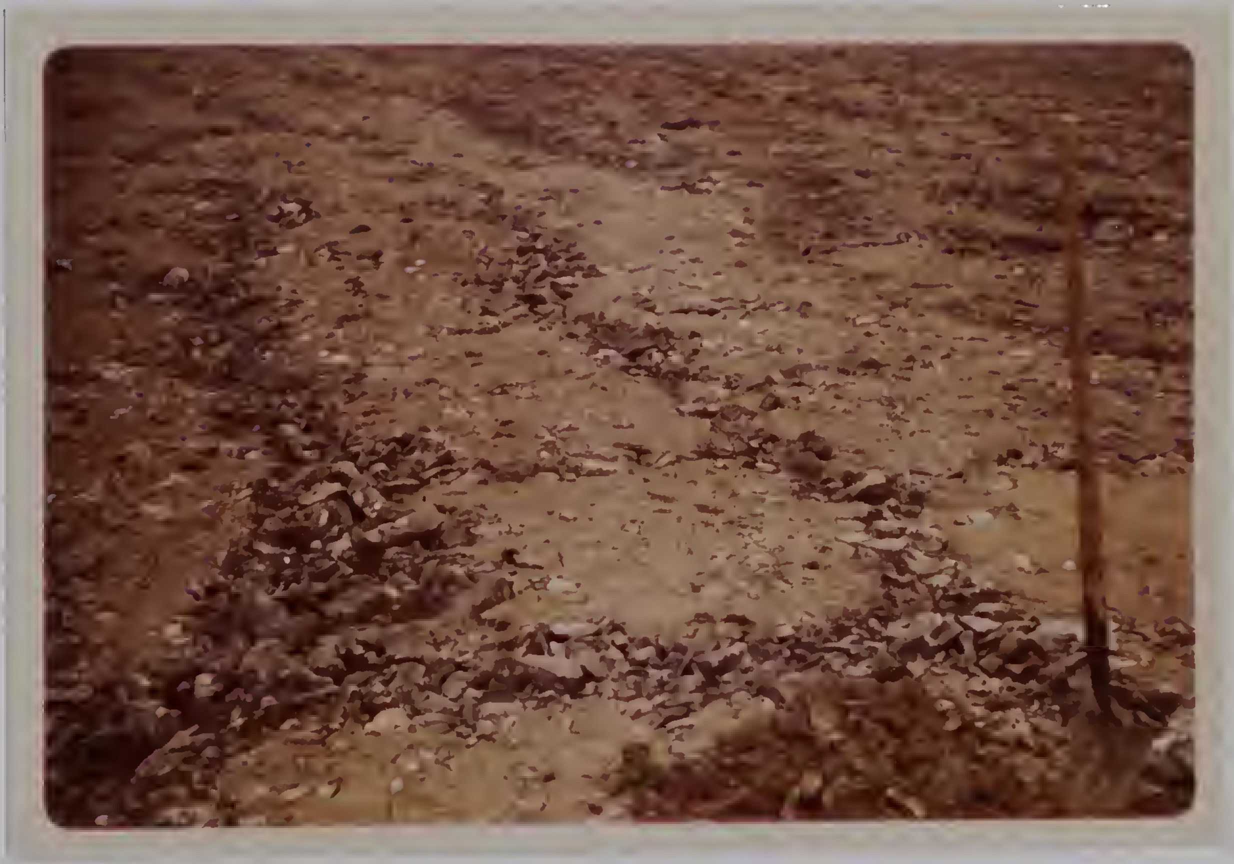

Plate 22. Sorted stripes typical of local upland terrain.

Except for lower vegetative cover, finer textures, and low salinity, soils of the local plateau area closely resemble profiles classed as Soils of the Polar Desert-Tundra Interjacence investigated in Ingelfield Land, Northwest Greenland (Tedrow 1970). Characteristic is a wide summer season change in moisture regime from near saturation in early summer to moist but firm conditions by late summer.

Analytical Features of Turbic Cryosols

Table 23 presents chemical and physical data for the Brunisolic and Gleysolic Turbic Cryosol profiles described in the preceding section.

Turbic Cryosols are similar to Static Cryosol counterparts with respect to analytical characteristics. The individuals presented in Table 23 are calcareous and base-rich (Ca and Mg dominating). Organic and organo-mineral horizons have a C/N ratio of about 12 to 1. Based on data from other sampling sites (see Appendix), the available nutrient status of Turbic Cryosols is comparable to corresponding Static Cryosols. Only textures, compared on similar parent materials, vary slightly, as general trends, between Turbic and Static Cryosol Great Groups (see following discussion on pedogenic trends).

Pedogenic Trends in Turbic Cryosols

Morphologic features, site characteristics, and analytical data (Table 23) are used to evaluate pedogenesis in Turbic Cryosols.

For the most part, comments in preceding pages regarding conventional pedogenic processes (mainly enrichment and chemical weathering) also apply to corresponding Turbic Cryosols. Congeliturbation (congelipedoturbation; Buol *et al.* 1973) is, however, the dominant process in Turbic Cryosol formation. Gelifluction generally cooperates in conjuntion

Table 23. Chemical and physical data for selected Turbic Cryosols

Horizon	Depth (cm)	pH	Org. Carbon %	Total N %	$CaCO_3$ Equiv. %	Exchangeable Cations (me/100g) H	Ca	Mg	Na	K	T.E.C. (me/100g)	Available Nutrients (ppm) NO_3-N	P	K	Na	SO_4-S	Oxalate Fe %	Al %	% Coarse Fragments (>2mm)	Particle Size Distribution (% of <2mm fraction) Sand (2.0 - 0.05mm)	Silt (0.05 - 0.002mm)	Clay (<0.002 mm)	Bulk Density (gm/cc)
Site 34 -- Brunisolic Turbic Cryosol in beach material (Bd 1) -- representative of map unit 41:																							
Ahky$_1$	0–36	7.4	16.5	1.40	3.9	-	71.2	18.7	0.2	0.3	87.6	-	-	-	-	-	0.43	-	<40*	-	-	-	-
Ahky$_2$	8–19	7.6	4.3	0.36	17.2	-	-	-	-	-	-	-	-	-	-	-	0.37	0.01	<30*	81	9	10	-
Bmky$_1$	20–29	7.9	-	-	24.0	-	-	-	-	-	-	-	-	-	-	-	0.22	Tr	<20*	84	10	6	-
Bmky$_2$	20–24	7.9	-	-	26.8	-	-	-	-	-	-	-	-	-	-	-	0.70	0.02	<20*	79	15	6	-
Cky	0–25	8.2	0.3	0.01	26.2	-	-	-	-	-	-	-	-	-	-	-	0.40	0.01	<20*	65	26	9	-
Cky	25–56	8.1	-	-	30.1	-	-	-	-	-	-	-	-	-	-	-	0.53	0.01	<20*	65	27	8	-
Site 35 -- Gleysolic Turbic Cryosol in undifferentiated material (Un) -- representative of map unit 61:																							
Ofy	18–0	7.2	25.9	2.21	1.3	-	63.7	21.2	0.3	0.3	86.7	-	-	-	-	-	0.40	0.02	<20*	-	-	-	-
Ckg	0–40	7.9	-	-	23.3	-	-	-	-	-	-	-	-	-	-	-	0.43	0.01	<20*	65	27	8	-
Ckgy	0–51	8.0	0.5	0.01	25.3	-	-	-	-	-	-	-	-	-	-	-	0.19	0.01	<10*	65	26	9	-
Site 29 -- Gleysolic Turbic Cryosol in till (Tg) of the plateau -- representative of map unit 62:																							
Ckgy$_1$	0–21	7.8	0.2	0.03	52.4	-	-	-	-	-	-	-	-	-	-	-	0.14	Tr	<20*	22	53	25	-
Ckgy$_2$	21–36	7.7	0.0	0.03	47.2	-	-	-	-	-	-	-	-	-	-	-	-	-	<20*	20	48	32	-

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* Visual estimate (% by volume)

with striped patterned ground and has only minor influence on soil formation in the study area.

Besides the disruption and displacement of horizons produced by other processes, congeliturbation also creates, via microrelief, dissimilar microenvironments. For example, trough positions of Brunisolic Turbic Cryosols (map unit 41) appear to accumulate more organic material than do adjacent areas with the same vegetation and Brunisolic Static Cryosols (map unit 12).

Actual mechanics of congeliturbation or factors that contribute to its operation are not well known. In the Lowland there appears to be a trend of slightly finer textures (particularly higher silt contents) in the Turbic Cryosol Great Group compared to the Static Cryosol Great Group This is more evident among Brunisolic than Gleysolic subgroups.

Miscellaneous Map Units

The remaining miscellaneous land types do not have subordinate soils as do map units 81 and 83 (described in preceding pages) but are dominated by rock land or rubble land.

Present-day marine beach and tideland areas belong to map unit 82. The material (Bd 4) forming these features is dominated, lithologically, by dolomite on and near Rocky Point to crystalline fragments adjacent to Truelove Inlet. All shapes and sizes of coarse fragments can be found. Most drainage situations also occur. Small areas of tideland located farthest inland have moderate vegetative cover and very shallow organic material accumulations.

Map unit 84 encompasses the dolomite plain (consolidated dolomite bedrock -- R1) that is Rocky Point. Shallow mineral gley soils and organic soils that occupy some local depressions (Plate 23), particularly

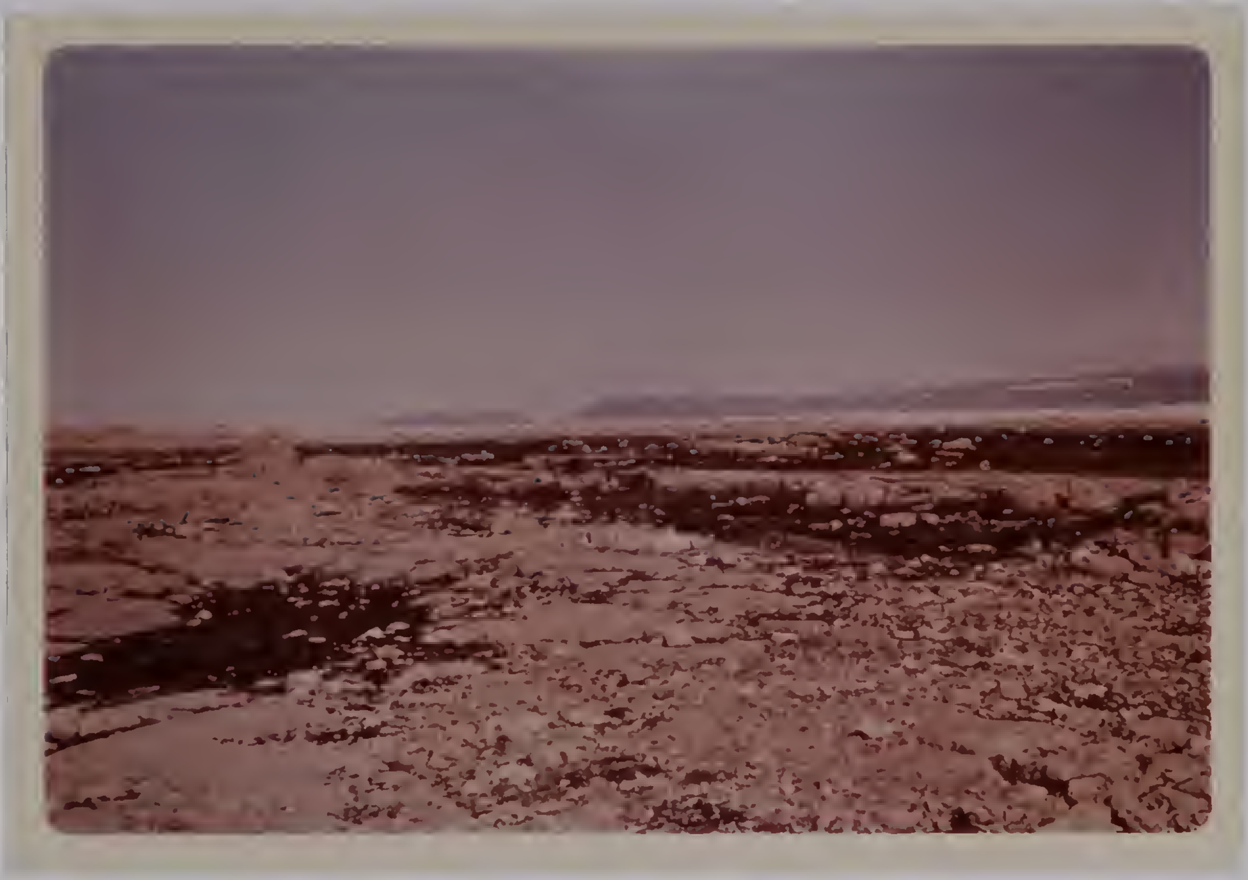


Plate 23. Dolomite plain (or limestone pavement) with small, vegetated depressions.

and ponds, are designated as minor inclusions.

Rubble land associated with present-day stream channels belongs to map unit 85. Angular dolomitic cobbles and stones predominate in this outwash (Ow 1).

Large cones of rock debris, invading the Lowland from the steeply sloping eastern escarpment but having their apices above its base, are apparently alluvial (Av 2) in origin. Map unit 86 designates these alluvial cones. The rubble, angular to thin, flat gravels to stones, is predominantly dolomite in origin.

Stony colluvium (Cv) forms an escarpment that marks the eastern boundary of the Truelove Lowland and rises some 250 to 300 m to a plateau which forms the main body of Devon Island. Map unit 87 incorporates the features of this escarpment. Lithologically, the angular to thin, flat rubble is dominated by dolomite with crystalline fragments increasing in number towards the escarpment base. Classed as extremely sloping with slope measurements averaging 35° (70%), well within the limits defining the angle of repose, the escarpment includes, amongst the rock rubble, occasional vertical prominences of consolidated dolomite bedrock and small "ledges" where fine earth mineral soils may occur.

Map unit 88 applies to those areas on the plateau, usually heights of land and steep, short slopes, characterized by thin, flat to angular rubble dominated by dolomitic stones. Rock circles (Washburn 1956) occur frequently in this material.

Soil - Drainage - Vegetation Relationships

Although environmental interactions are rather complex throughout the study area, drainage (or moisture regime) is considered to be dictating local pedogenic trends. Moisture status also exerts a marked selective

influence on plant populations (Table 3). Consequently, relationships among soils, vegetation communities, and drainage are quite predictable until conditions of severely restricted drainage are encountered. In such situations, soil differences, from a classification viewpoint, remain considerable whereas plant community differences become more subtle as compared to drier sites. Figure 11, using generalized profile diagrams to represent six major soils of the Truelove Lowland, shows soil-vegetation trends along the moisture gradient.

Drainage patterns are not governed by topographic situation alone. Information from the line transects (Fig. 12, 13, 14, 15, and 16) readily illustrates that topographic variance (relief) is subtle, yet complex patterns of drainage, soils, and vegetation exist. This is especially true in moderately well to very poorly drained areas. Localities with relatively free drainage tend to be elevated above surrounding landscape but are usually characterized by steep, very short, slope margins that are not evident in the transects.

Most drainage is lateral rather than vertical because of the impervious frost layer at shallow depths. Thus most soil water is from snowmelt and active layer thaw. This also introduces, as factors in determining soil features and vegetative cover, hydrodynamics of lateral flow and amplitudes of moisture status change over the summer season (particularly evident in Gleysoilc Turbic Cryosols).

In summary, subtle aspects of drainage other than rate of water supply versus rate of removal must be considered for partial explanation of the differences in profile development encountered, especially in wet sites. In addition, concepts regarding drainage and soil development should be re-evaluated as they apply to northern environments.

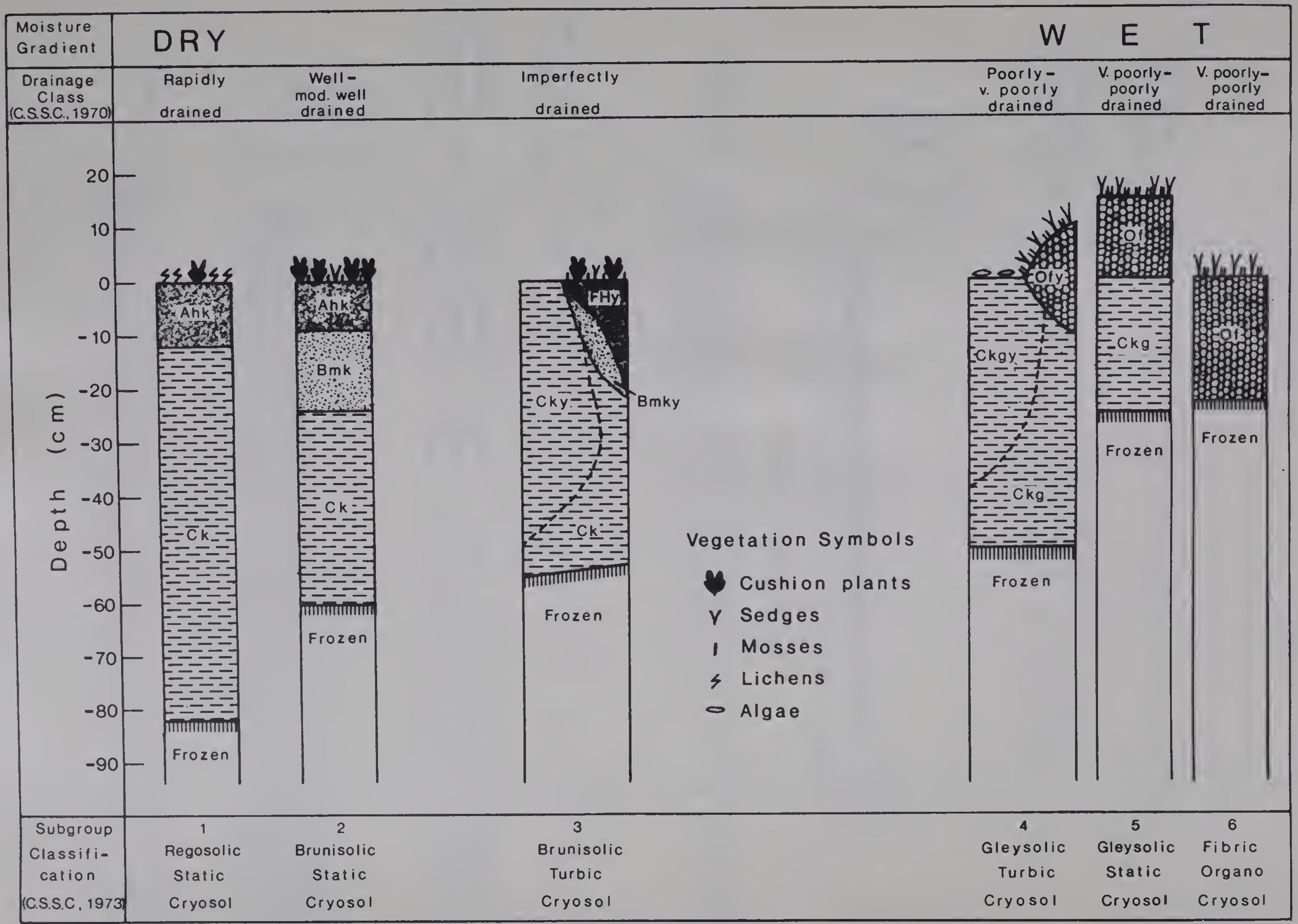


Figure 11. Diagrammatic representations of 6 major types of soil development, arranged according to moisture gradient, occurring on the Truelove Lowland.

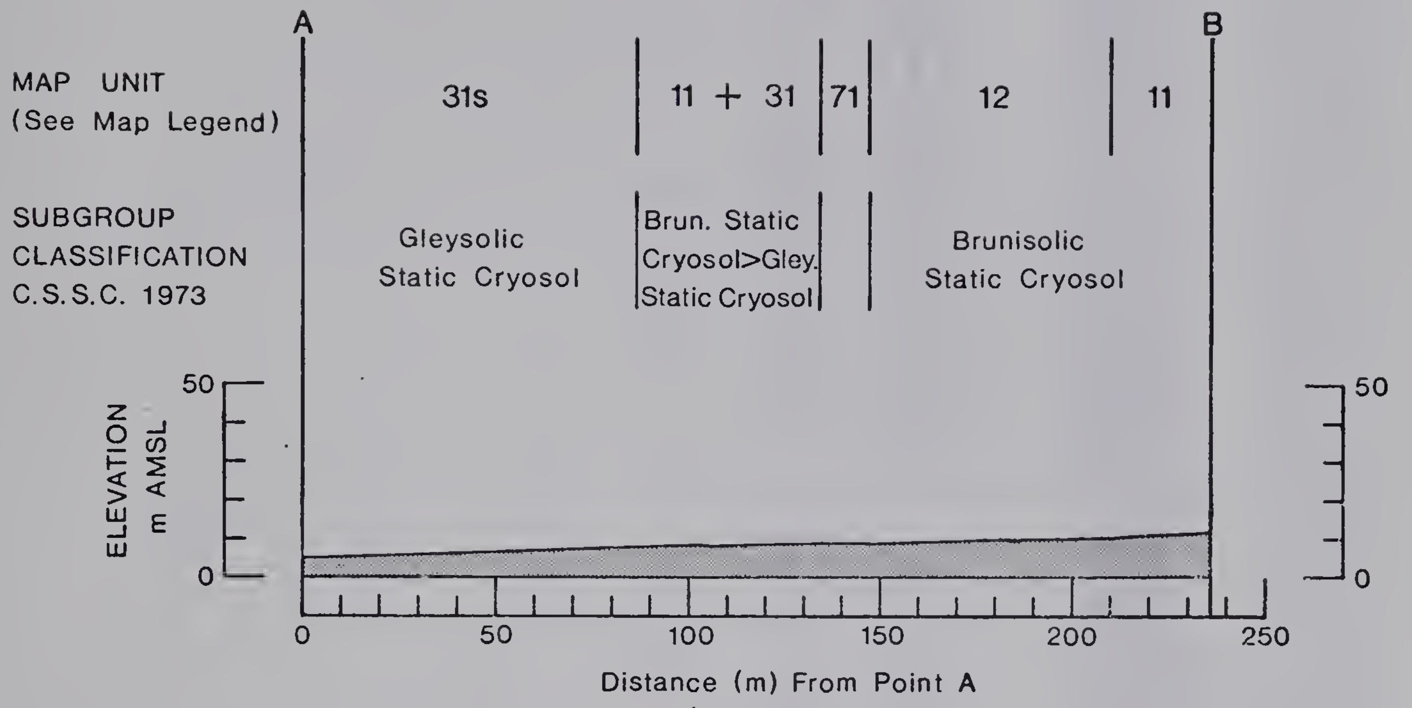


Figure 12. Diagram of Transect No. 1 (see Fig. 3 for location). Map unit and soil subgroup variability is related to topographic change along the transect. Refer to the map legend for additional information.

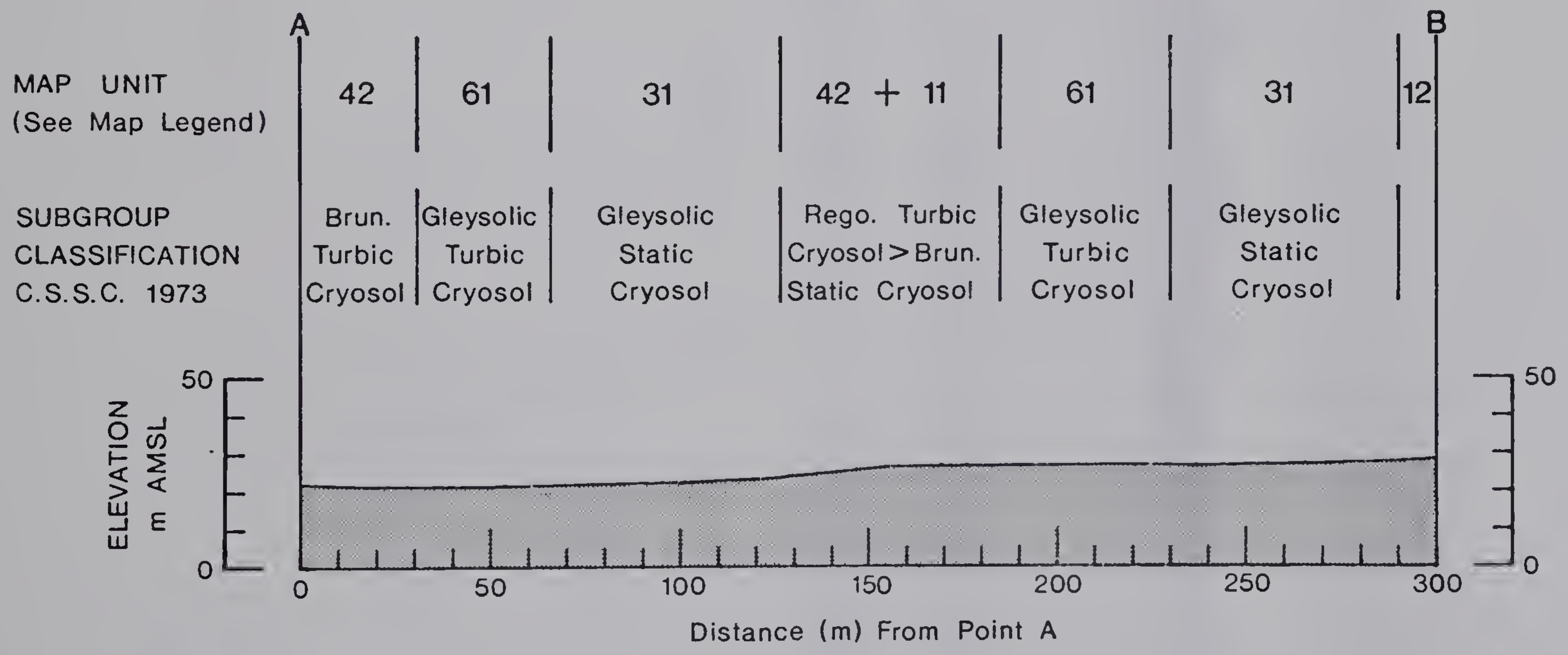
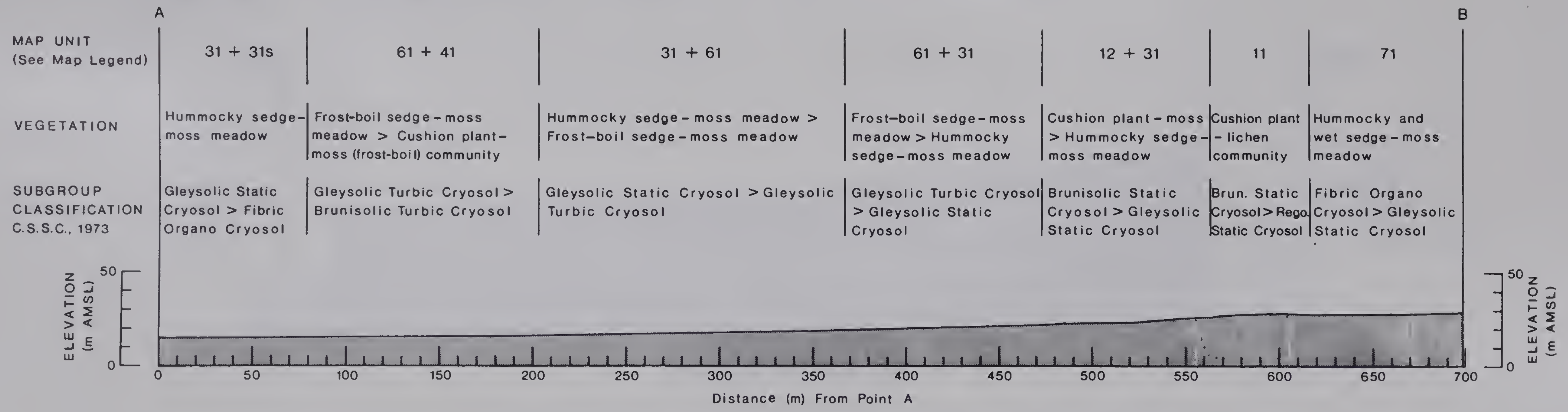


Figure 13. Diagram of Transect No. 3 (see Fig. 3 for location). Map unit and soil subgroup variability is related to topographic change along the transect. Refer to the map legend for additional information.



MAP UNIT (See Map Legend)	31 + 31s	61 + 41	31 + 61	61 + 31	12 + 31	11	71
VEGETATION	Hummocky sedge-moss meadow	Frost-boil sedge-moss meadow > Cushion plant-moss (frost-boil) community	Hummocky sedge-moss meadow > Frost-boil sedge-moss meadow	Frost-boil sedge-moss meadow > Hummocky sedge-moss meadow	Cushion plant-moss > Hummocky sedge-moss meadow	Cushion plant-lichen community	Hummocky and wet sedge-moss meadow
SUBGROUP CLASSIFICATION C.S.S.C., 1973	Gleysolic Static Cryosol > Fibric Organo Cryosol	Gleysolic Turbic Cryosol > Brunisolic Turbic Cryosol	Gleysolic Static Cryosol > Gleysolic Turbic Cryosol	Gleysolic Turbic Cryosol > Gleysolic Static Cryosol	Brunisolic Static Cryosol > Gleysolic Static Cryosol	Brun. Static Cryosol > Rego. Static Cryosol	Fibric Organo Cryosol > Gleysolic Static Cryosol

Figure 14. Diagram of Transect No. 2 (see Fig. 3 for location). Map unit, vegetation, and soil subgroup variability is related to topographic change along the transect. Refer to the map legend for additional information.

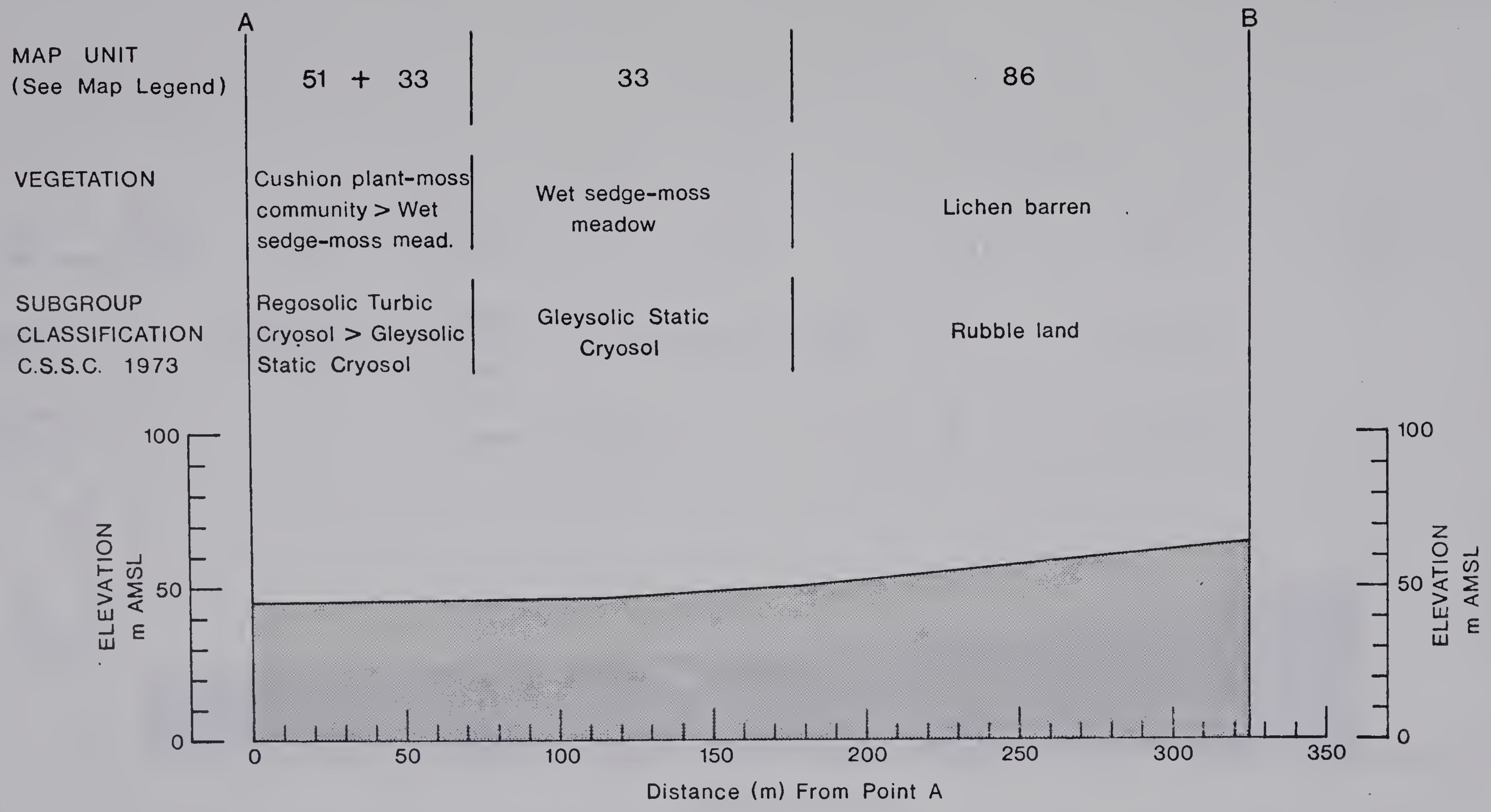

A
B
MAP UNIT
(See Map Legend)
51 + 33
33
86
VEGETATION
Cushion plant-moss community > Wet sedge-moss mead.
Wet sedge-moss meadow
Lichen barren
SUBGROUP CLASSIFICATION C.S.S.C. 1973
Regosolic Turbic Cryosol > Gleysolic Static Cryosol
Gleysolic Static Cryosol
Rubble land
ELEVATION m AMSL
100
50
0
0
50
100
150
200
250
300
350
Distance (m) From Point A

Figure 15. Diagram of Transect No. 4 (see Fig. 3 for location. Map unit, vegetation, and soil subgroup variability is related to topographic change along the transect. Refer to the map legend for additional information.

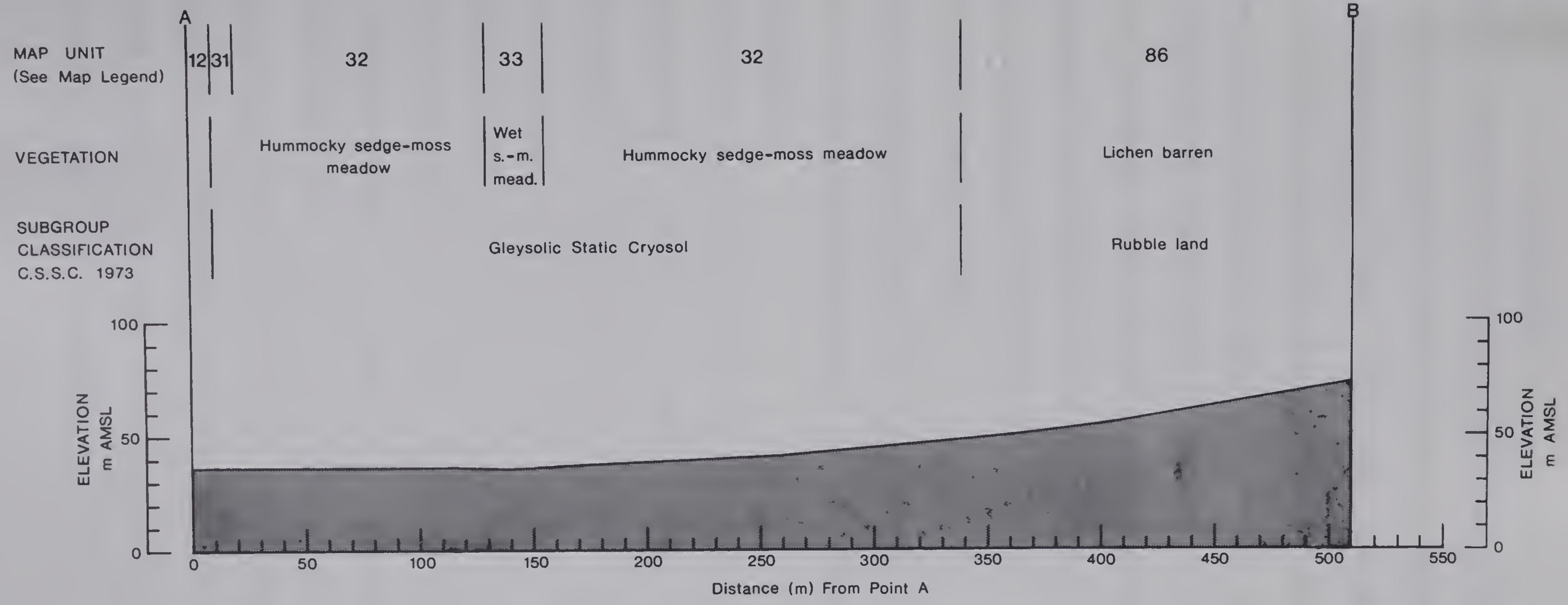


Figure 16. Diagram of Transect No. 5 (see Fig. 3 for location). Map unit, vegetation, and soil subgroup variability is related to topographic change along the transect. Refer to the map legend for additional information.

CONCLUSION

Using generally accepted soil survey techniques, CCIBP's Tundra Biome study area on Devon Island was investigated for purposes of determining kinds and distribution of soils. This study area encompasses costal lowland, not unlike sedge-grass tundra found in the Low Arctic (Bliss 1975a), and interior plateau or upland, analogous to Polar Desert (Tedrow 1973b). Evidence to support such an anomaly are found in the differing vegetation patterns, soil morphologies, and climatic conditions.

Soil separations to the subgroup level of classification were accomplished using the tentative classification system for northern soils -- the Cryosolic Order (C.S.S.C. 1973). By definition the Cryosolic Order and its Great Groups recognize the peculiar soil-forming environment of the Arctic and most cyclic pedons resulting from congeliturbation (or cryoturbation) processes.

Within subgroups, separations based on parent material differences and approximating the soil series level of generalization were made. Twenty-seven "soil series" and miscellaneous soils were identified. These taxonomic units, or intimate combinations (complexes) of them, formed the bases for developing map units (24) used to depict the distribution of soils at a scale of 1:15,000 (see soil map in back pocket).

The most striking distinction concerning soil variability and distribution within the study area is that the Lowland sector is characterized by complexity whereas the upland (plateau) is typified by relative simplicity or uniformity. Soil subgroup and vegetation communities (Muc and Bliss 1976) correlate best with drainage patterns that are the product of subtle relief differences, impervious permafrost, and lateral meltwater flow.

Freely drained (rapidly to moderately well drained classes; C.S.S.C. 1970, 1974) soils are Regosolic Static Cryosols (A-C-Cz horizon sequence) and Brunisolic Static Cryosols (A-B-C-Cz horizon sequence) with cushion plant-lichen and cushion plant-moss communities(Muc and Bliss 1976). Occurring in coarse-skeletal to coarse, calcareous, beach deposits of raised beach landforms, these soils represent a continuum of increasing horizon differentiation from dry raised beach crests to moist lower slopes. Characteristic are dark brown organo-mineral A horizons and brownish B horizons. Morphological and analytical evidence indicate that processes of carbonate translocation, littering, partial humification, melanization, and, perhaps in some cases, slight braunification (Buol *et al.* 1973) operate to form these types of profiles.

Brunisolic Static Cryosols resemble Arctic Brown soils described on Banks Island (Tedrow and Douglas 1964) and Prince Patrick Island (Tedrow *et al.* 1968) Except for a shallow Arctic Brown profile characterized by Tedrow (1970), arctic soils resembling Regosolic Static Cryosols of the study area have not been described in the literature. Based on an extensive literature survey and a few observations elsewhere on Canada's Arctic Islands, soils with these types of development must be considered unique in the High Arctic.

Poorly and very poorly drained Lowland areas with calcareous, coarse-textured (undifferentiated and till) to noncalcareous, medium-textured (alluvial-lacustrine) deposits have Gleysolic Static Cryosols and Fibric Organo Cryosols under hummocky sedge-moss meadow and wet sedge-moss meadow plant communities (Muc and Bliss 1976). These represent a continuum of littering to paludization processes (Buol *et al.* 1973) that have resulted in substantially thick surface accumulations of a fairly compact, fibrous

organic material derived from sedges and *Hypnum* mosses. It is suggested that the varying peat thicknesses reflect restricted lateral flow in shallow basins versus relatively unrestrained flow in gentle slopes rather than age.

Symptoms of gleization (bluish colors, mottles) are only weakly expressed in the Gleysolic subgroups of the study area. This feature agrees with Tedrow's views on pedogenic gradients in polar regions (Tedrow 1968, 1973b). However, gley and organic soils with significant organic layer thicknesses and extensive distribution, as occur on the Truelove Lowland, have not been previously reported for High Arctic areas. Again, the uniqueness of the Lowland is illustrated. Salinized or alkalized soils were not found in the study area.

Lowland soils exhibiting imperfect to poor drainage, texture with slightly more silt, and some degree of drying over the summer season are Turbic Cryosols. In these soils congeliturbation, manifest by circle, net, and stripe patterned ground meshes, dominates the soil-forming processes. Pedons (Soil Survey Staff 1960) used to describe and classify these soils extend from frost-boil center to vegetated trough center.

Brunisolic and Regosolic Turbic Cryosols are associated with calcareous, coarse to coarse-skeletal, beach and till deposits and cushion plant-moss vegetation with frost-boils (*ca* 40% of surface area). Horizons similar to those in Regosolic and Brunisolic subgroups of the Static Cryosols but with a discontinuous and irregular distribution occur under vegetated troughs.

Gleysolic Turbic Cryosols, most frequently associated with calcareous, moderately coarse undifferentiated materials, account for nearly 50% of the Lowland wetlands. Frost-boil sedge-moss meadow vegetation (Muc and

Bliss 1976) and discontinuous, surface organic horizons, very similar to the unbroken peat accumulations on Gleysolic Static Cryosols, are characteristic.

Gleysolic Turbic Cryosols that lack surface organic accumulations occur extensively in the calcareous, fine-textured till of the plateau to the east of the Truelove Lowland. These soils, not unlike Soils of the Polar Desert-Tundra Interjacence (Tedrow 1970, 1973b), reflect local "Polar Desert" conditions and are the most unique within the study area.

In summary, the uniform soil cover of the upland sector of the study area is reasonably typical of local Polar Desert or High Arctic conditions. But on the Lowland sector there exists a very complex soil cover that reflects some Low Arctic or Tundra Zone pedogenic trends (littering, paludization, humification, melanization, and, perhaps, brauification) modified by a more severe High Arctic climate that results in shallow active layers, carbonate translocation, and weak gleization. Cryoturbated (or congiliturbated) soils, common to both Low Arctic and High Arctic zones, occur extensively throughout the study area.

BIBLIOGRAPHY

Addison, P.A. 1976. Studies on evaporation and energy budgets on the Truelove Lowland. In: Truelove Lowland, Devon Island, Canada: High Arctic Ecosystem. L.C. Bliss (ed.) (In press)

Aleksandrova, V.D. 1970. Vegetation and primary productivity in the Soviet Subarctic. 93-114. In: Productivity and Conservation in Northern Circumpolar Lands. W.A. Fuller and P.G. Kevan (eds.). Morges, Switzerland: IUCN N. Ser. No. 16. 344 pp.

Allison, L.E., Bollen, W.B., and Moodie, C.D. 1965. Total carbon. 1346-1366. In: Methods of Soil Analysis, Part 2: Chemical and Microbiological Properties. C.A. Black (ed.-in-chief). Agron. Monog. No. 9. Amer. Soc. Agron., Inc., Madison, Wisconsin.

Anonymous. 1973. Glossary of Soil Science Terms. Soil Sci. Soc. Amer. Madison, Wisconsin. 33 pp.

Association of Official Agricultural Chemists (AOAC). 1955. Official Methods of Analysis. 8th ed. Washington, D.C. 1008 pp.

Barr, W. 1971. Postglacial isostatic movement in Northeastern Devon Island: A reappraisal. Arctic 24: 249-268.

Barrett, P.E. 1972. Phytogeocoenoses of a coastal lowland ecosystem, Devon Island, N.W.T. Ph. D. Thesis. Univ. of British Columbia, Vancouver, B.C. 292 pp.

Barrett, P.E. and Teeri, J.A. 1973. Vascular plants of the Truelove Inlet region, Devon Island. Arctic 26: 58-67.

Barry, R.G. and Hare, F.K. 1974. Arctic climate. 17-53. In: Arctic and Alpine Environments. J.D. Ives and R.G. Barry (eds.). Metheun and Co. Ltd., London. 999 pp.

Bascombe, C.L. 1961. A calcimeter for routine use on soil samples. Chemistry and Industry Part II: 1826-1827.

Bliss, L.C. 1971. Devon Island, Canada high-arctic ecosystem. Biol. Conserv. 3: 229-231

Bliss, L.C. 1975a. Tundra grasslands, herblands, and shrublands and the role of herbivores. Geoscience and Man 10: 51-79.

Bliss, L.C. 1975b. Devon Island, Canada. 17-60. In: Structure and Function of Tundra Ecosystems. T. Rosswall and O.W. Heal (eds.) Stockholm: Swedish Natural Science Research Council. Ecol. Bull. 20. 450 pp.

Bliss, L.C., Courtin, G.M., Pattie, D.L., Riewe, R.R. Whitfield, D.W.A., and Widden P. 1973. Arctic tundra ecosystems. Ann. Rev. Ecol. Syst. 4: 359-399.

Bliss, L.C., Kerik, J., and Peterson, W. 1976. Primary production of dwarf shrub-heath communities. In: Truelove Lowland, Devon Island, Canada: High Arctic Ecosystem. L.C. Bliss (ed.). (In press).

Brown, J. 1966. Soils of the Okpilak River region, Alaska. U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, N.H. Research Rpt. 188. 49 pp.

Brown, J. 1967. Tundra soils formed over ice wedges, Northern Alaska. Soil Sci. Soc. Amer. Proc. 31: 686-691.

Brown, R.J.E. 1976. Permafrost investigations in the Truelove Lowland, Devon Island, N.W.T. In: Truelove Lowland, Devon Island, Canada: High Arctic Ecosystem. L.C. Bliss (ed.). (In press).

Brown, J. and Tedrow, J.C.F. 1964. Soils of the Northern Brooks Range, Alaska: 4. Well-drained soils of the glaciated valleys. Soil Sci. 97: 187-195.

Buckman, H.O. and Brady, N.C. 1960. The Nature and Properties of Soils. 6th ed. Collier-Macmillan Canada, Ltd., Toronto. 567 pp.

Buol, S.W., Hole, F.D., and McCracken, R.J. 1973. Soil Genesis and Classification. The Iowa State Univ. Press, Ames, Iowa. 360 pp.

Canadian Soil Survey Committee (C.S.S.C.). 1970. The System of Soil Classification for Canada. Can. Dept. Agric. Queen's Printer, Ottawa. 249 pp.

Canadian Soil Survey Committee (C.S.S.C.). 1973. Report of the working group on northern soils: Tentative classification system for Cryosolic soils. 346-358. In: Proceedings of the Ninth Meeting of the Canada Soil Survey Committee. J.H. Day and P.G. Lajoie (eds.). Univ. of Saskatchewan, Saskatoon. 358 pp.

Canada Soil Survey Committee (C.S.S.C.). 1974. The System of Soil Classification for Canada - revised. Can. Dept. Agric. Publ. 1455. Information Canada, Ottawa. 255 pp.

Chapman, H.D. 1965. Cation exchange capacity. 891-901. In: Methods of Soil Analysis, Part 2: Chemical and Microbiological Properties. Agron. Monog. No. 9. Amer. Soc. Agron., Inc., Madison, Wisconsin.

Courtin, G.M. and Labine, C.L. 1976. Microclimatological studies of the Truelove Lowland. In: Truelove Lowland, Devon Island, Canada: High Arctic Ecosystem. L.C. Bliss (ed.). (In press).

Cruickshank, J.G. 1971. Soils and terrain units around Resolute, Cornwallis Island. Arctic 24: 195-209.

Day, J.H. 1964. Characteristics of soils of the Hazen Camp area, Northern Ellesmere Island, N.W.T. Defence Research Board, Ottawa. Hazen

Rpt. 24. 15 pp.

Day, P.R. 1965. Particle fractionation and particle-size analysis. 545-567. In: Methods of Soil Analysis, Part I: Physical and Mineralogical Properties Including Statistics of Measurement and Sampling. Agron. Monog. No. 9. Amer. Soc. Agron., Inc., Madison, Wisconsin.

Day, J.H. and Rice, H.M. 1964. The characteristics of some permafrost soils in the Mackenzie Valley, N.W.T. Arctic 17: 222-236.

Dickman, S.R. and Bray, R.H. 1940. Colorimetric determination of phosphate. Ind. Eng. Chem. Anal. Ed. 12: 665-668.

Doughty, J.L. 1941. The advantages of a soil paste for routine pH determinations. Soil Sci. 22: 135-138.

Douglas, L.A. and Tedrow, J.C.F. 1960. Tundra soils of Arctic Alaska. Proc. 7th Int. Soil Sci. Congr., Comm. V, Vol. IV: 291-304.

Drew, J.V. and Tedrow, J.C.F. 1957. Pedology of an Arctic Brown profile near Point Barrow, Alaska. Soil Sci. Soc. Amer. Proc. 21: 336-339.

Everett, K.R. 1968. Soil development in the Mould Bay and Isachsen areas, Queen Elizabeth Islands, Northwest Territories, Canada. Inst. of Polar Studies, Ohio State Univ., Columbus, Ohio. Research Rpt. No. 24. 75 pp.

Everett, K.R. 1974. Principal soils and geomorphic units of the Barrow sites. U.S. Tundra Biome Data Rpt. 74-7. 45 pp.

Flint, R.F. 1971. Glacial and Quaternary Geology. John Wiley and Sons, Inc., Toronto. 892 pp.

Gerasimov, I.P. and Glazovskaya, M.A. 1965. Fundamentals of Soil Science and Soil Geography. Translation from Russian by Isreal Program for Sci. Transl., Jerusalem. 382 pp.

Glinka, H.D. 1927. The Great Soil Groups of the World and Their Development. Translated from German by C.F. Marbut. Edwards Brothers, Ann Arbor, Michigan. 235 pp.

Glinka, K.D. 1963. Treatise on Soil Science. Translated from 4th Russian ed. by Israel Program for Sci. Transl., Jerusalem. 674 pp.

Gorshenin, K.P. 1963. Basic principles in the classification of Siberian soil. Sov. Soil Sci., No. 1: 15-19.

Hare, F.K. and Ritchie, J.C. 1972. The boreal bioclimates. Geogr. Rev. 62: 333-365.

Hill, D.E. and Tedrow, J.C.F. 1961. Weathering and soil formation in the arctic environment. Amer. J. Sci. 259: 84-101.

Holowaychuk, N. and Everett, K.R. 1972. Soils of the Tasersiaq area, Greenland. Medd. om Gronland, Bd. 188, No. 6. 37 pp.

Holowaychuk, N., Petro, J.H., Finney, H.R., Farnham, R.S., and Gersper, P.L. 1966. Soils of Ogotoruk Creek Watershed. 221-273. In: Environment of the Cape Thompson Region, Alaska. N.J. Wilmovsky and J.N. Wolfe (eds.). U.S. Atomic Energy Commission, Div. of Techn. Infor. Oak Ridge, Tenn. 1250 pp.

Hopkins, D.M. and Sigafoos, R.S. 1951. Frost action and vegetation patterns on Seward Peninsula, Alaska. Geological Survey Bull. 974-C. 101 pp.

Ignatenko, I.V. 1963. Arctic tundra soils of the Yugor Peninsula. Sov. Soil Sci., No. 5: 429-440.

Ignatenko, I.V. 1965. The characteristics of soil formation in the different subzones of the eastern European tundra. Problems of the North, No. 8: 213-225.

Ignatenko, I.V. 1966. Vaygach Island soils. Sov. Soil Sci., No. 9: 991-998.

Ignatenko, I.V. 1971. Soils in the Kara River Basin and their zonal position. Sov. Soil Sci., No. 2: 15-28.

Ignatenko, I.V. 1973. Soils of the main types of Tundra biocoenoses in Western Taymyr. U.S. Army Cold Regions Research and Engineering Laboratory Draft. Transl. 408. Hanover, N.H. 67 pp.

Ivanova, Ye. N., Rozov, N.N., Yerokhina, A.A., Nogina, N.A., Nosin, V.A., and Utimtseva, K.A. 1961. New materials on the general geography and classification of soils in the polar and boreal belts of Siberia. Sov. Soil Sci., No. 11: 1171-1181.

James, P.A. 1970. The soils of the Rankin Inlet area, Keewatin, N.W.T., Canada. Arctic and Alpine Research 2: 293-302.

Joffe, J.S. 1949. Pedology. 2nd ed. Pedology Publ., New Brunswick, N.J. 662 pp.

Karavayeva, N.A., Sokolov, I.A., Sokolova, T.A., and Targul'yan, V.V. 1965. Peculiarities of soil formation in the tundra taiga frozen regions of eastern Siberia and the Far East. Sov. Soil Sci., No. 7: 756-766.

Kilmer, V.T. and Alexander, L.T. 1949. Methods of making mechanical analysis of soils. Soil Sci. 68: 15-24.

King, R.H. 1969. Periglaciation on Devon Island, N.W.T. Ph.D. Thesis. Univ. of Saskatchewan, Saskatoon. 470 pp.

Kreida, N.A. 1958. Soils of the Eastern European tundras. Sov. Soil Sci., No. 1: 51-56.

Krupicka, J. 1973. Granulite facies rocks on Northeastern Devon Island, Arctic Archipelago. Geol. Surv. Can. Paper. 73-8. 41 pp.

Krupicka, J. 1976. Bedrock geology of the Truelove River area. In: Truelove Lowland, Devon Island, Canada: High Arctic Ecosystem. L.C. Bliss (ed.). (In press).

Kubiena, W.L. 1953. The Soils of Europe. Thomas Murky and Co., London. 318 pp.

Leahey, A. 1969. The soils of Canada from a pedological viewpoint. 113-124. In: Vegetation, Soils and Wildlife. J.G. Nelson and M. J. Chambers (eds.). Methuen, Toronto. 372 pp.

Liverovskii, Yu. A. 1965. Soils of the far north and problems of their future study. Problems of the North, No. 8: 165-179.

Matveyeva, N.V., Polozova, T.G., Blagodatskykh, L.S., and Dorogostaiskaya, E.V. 1974. A brief essay on the vegetation in the vicinity of the Taimyr Biogeocoenological Station. Int. Tundra Biome (IBP) Transl., Univ. of Colorado. 56 pp.

McKeague, J.A. and Day, J.H. 1966. Dithionite - and oxalate - extractable Fe and Al as aids in differentiating various classes of soil. Can. J. Soil Sci. 46: 13-22.

McMillan, N.J. 1960. Soils of the Queen Elizabeth Islands (Canadian Arctic). J. Soil Sci. 11: 131-139.

Mikhaylov, I.S. 1960. Some features of sod arctic soils on Bolshevik Island. Sov. Soil Sci., No. 6: 649-652.

Mikhaylov, I.S. 1961. Soil investigations in Northern Alaska. Sov. Soil Sci., No. 2: 209-214.

Muc, M. 1976. Ecology and primary production of the Lowland sedge-moss meadow communities. In: Truelove Lowland, Devon Island, Canada: High Arctic Ecosystem. L.C. Bliss (ed.) (In press.)

Muc, M. and Bliss, L.C. 1976. Plant communities of the Truelove Lowland. In: Truelove Lowland, Devon Island, Canada: High Arctic Ecosystem. L.C. Bliss (ed.). (In press).

National Soil Survey Committee of Canada. 1963. Report on the Fifth Meeting of the National Soil Survey Committee of Canada. Winnipeg, Manitoba. 92 pp.

Odum, E.P. 1971. Fundamentals of Ecology. 3rd ed. W.B. Saunders Co., Toronto. 574 pp.

Pawluk, S. and Brewer, R. 1975. Micromorphological and analytical characteristics of some soils from Devon and King Christian Islands, N.W.T. Can. J. Soil Sci. 55: 349-361.

Peters, T.W. and Walker, B. 1972. Preliminary soil investigations on the Truelove Lowlands, Devon Island, N.W.T. 11-29. In: Devon Island I.B.P. Project: High Arctic Ecosystem. Project Report 1970 and 1971. L.C. Bliss (ed.). Univ. of Alberta Printing Services, Edmonton, 413 pp.

Polunin, N. 1951. The real arctic: Suggestions for its delimitation, subdivision, and characterization. J. Ecol. 39: 308-315.

Porsild, A.E. 1951. Plant life in the arctic. Can. Geogr. J. 42: 120-145.

Prince, A.L. 1952. Determination of total nitrogen, ammonia, nitrates, and nitrites in soils. Soil Sci. 59: 47-52.

Rae, R.W. 1951. Climate of the Canadian Arctic Archipelago. Can. Dept. Transport, Toronto. 90 pp.

Richardson, D.H.S. and Finegan, E.J. 1976. Studies on the lichens of Truelove Lowland. In: Truelove Lowland, Devon Canada: High Arctic Ecosystem. L.C. Bliss (ed.). (In Press.)

Rieger, S. 1966. Dark well-drained soils of the tundra regions in Western Alaska. J. Soil Sci. 17: 164-173.

Rozov, N.N. and Ivanova, Ye. N. 1967a. Classification of the soils of the U.S.S.R.: Principles and a systematic list of soil groups. Sov. Soil Sci., No. 2: 147-156.

Rozov, N.N. and Ivanova, Ye. N. 1967b. Classification of the soils of the U.S.S.R.: Genetic description and identification of the principal subdivisions. Sov. Soil Sci., No. 3: 288-300.

Rozov, N.N. and Ivanova, Ye. N. 1968. Soil classification and nomenclature used in Soviet pedology, agriculture and forestry. 53-77. In: Approaches to Soil Classification: Soil Map of the World FAO/UNESCO Project, Rome. World Soil Resource Rpt. 32. 143 pp.

Soil Survey Staff. 1960. Soil Classification: A Comprehensive System, 7th Approximation. Soil Conserv. Service, USDA, Washington, D.C. 265 pp.

Soil Survey Staff. 1970. Selected chapters from the unedited text of the soil taxonomy of the National Cooperative Soil Survey. Soil Conserv. Service, USDA, Washington, D.C.

Soil Survey Staff. 1974. Soil Taxonomy of the National Cooperative Soil Survey. Soil Conserv. Service, USDA, Washington, D.C.

Sokolov, I.A. and Sokolova, T.A. 1962. Zonal soil groups in permafrost regions. Sov. Soil Sci., No. 10: 1130-1136.

Svatkov, N.M. 1958. Soils of Wrangel Island. Sov. Soil Sci., No. 1: 80-87.

Svatkov, N.M. 1961. Natural features of Wrangel Island. Problems of the North, No. 4: 1-24.

Svoboda, J. 1972. Vascular plant productivity studies of raised beach ridges (semi-Polar Desert) in the Truelove Lowland. 146-184. In: Devon Island I.B.P. Project: High Arctic Ecosystem. Project Report 1970 and 1971. Univ. of Alberta Printing Services, Edmonton. 413 pp.

Svoboda, J. 1976. Ecology and primary production of raised beach communities, Devon Island. In: Truelove Lowland, Devon Island, Canada: High Arctic Ecosystem. L.C. Bliss (ed.). (In press.)

Targul'yan, V.O. and Karvayeva, N.A. 1965. Experience in the soil-geochemical classification of polar regions. Problems of the North, No. 8: 227-239.

Tedrow, J.C.F. 1962. Morphological evidence of frost action in arctic soils. Biuletyn Peryglacjalny Nr. 11: 343-352.

Tedrow, J.C.F. 1965. Concerning genesis of the buried organic matter in Tundra soil. Soil Sci. Soc. Amer. Proc. 29: 89-90.

Tedrow, J.C.F. 1966a. Arctic soils. Proc. Permafrost Int. Conf. (1963). National Academy Sci.-National Research Council Publ. 1287: 50-55.

Tedrow, J.C.F. 1966b. Polar Desert soils. Soil Sci. Soc. Amer. Proc. 30: 381-387.

Tedrow, J.C.F. 1968. Pedogenic gradients of the polar regions. J. Soil Sci. 19: 197-204.

Tedrow, J.C.F. 1970. Soil investigations in Inglefield Land, Greenland. Medd. om Gronland, Bd. 188, Nr. 3. 93 pp.

Tedrow, J.C.F. 1973a. Polar soil classification and the periglacial problem. Biuletyn Peryglacjalny Nr. 22: 285-294.

Tedrow, J.C.F. 1973b. Soils of the polar region of North America. Biuletyn Peryglacjalny Nr. 23: 157-165.

Tedrow, J.C.F. and Hill, D.E. 1955. Arctic Brown soil. Soil Sci. 80: 265-275.

Tedrow, J.C.F. and Cantlon, J.E. 1958. Concepts of soil formation and classification in arctic regions. Arctic 11: 166-179.

Tedrow, J.C.F. and Brown, J. 1962. Soils of the Northern Brooks Range, Alaska: Weakening of the soil-forming potential at high arctic altitudes. Soil Sci. 93: 254-261.

Tedrow, J.C.F. and Douglas, L.A. 1964. Soil investigations on Banks Island. Soil Sci. 98: 53-65.

Tedrow, J.C.F., Drew, J.V., Hill, D.E., and Douglas, L.A. 1958. Major genetic soils of the Arctic Slope of Alaska. J. Soil Sci. 9: 33-45.

Tedrow, J.C.F., Bruggemann, P.F., and Walton, G.F. 1968. Soils of Prince Patrick Island. Arctic Inst. of North Amer., Montreal. Research Rpt. No. 44. 82 pp.

Toogood, J.A. and Peters, T.W. 1953. Comparisons of methods of mechanical analysis of soils. Can. J. Agr. Sci. 33: 159-171.

Ugolini, F.C. 1966a. Soils of the Mesters Vig District, Northeast Greenland: 1. The Arctic Brown and related soils. Medd om Gronland, Bd. 176, Nr. 1. 23 pp.

Ugolini, F.C. 1966b. Soils of the Mesters Vig District, Northeast Greenland: 2. Exclusive of Arctic Brown and podzol-like soils. Medd. om Gronland, Bd. 176, Nr. 2. 27 pp.

Vitt, D.H. and Pakarinen, P. 1976. The bryophyte vegetation, production, and organic components in Truelove Lowland, Devon Island, Canada. In: Truelove Lowland, Devon Island, Canada: High Arctic Ecosystem. L.C. Bliss (ed.). (In press).

Washburn, A.L. 1956. Classification of patterned ground and review of suggested origins. Bull. Geol. Soc. Amer. 67: 823-866.

Washburn, A.L. 1973. Periglacial Processes and Environments. Edward Arnold, London. 320 pp.

Weller, G. and Cubley, S. 1972. The microclimate of the arctic tundra. 85-100. In: Proc. of the 1972 Tundra Biome Symposium. S. Bowen (ed.). Lake Wilderness Center, Univ. of Washington. 211 pp.

Zoltai, S.C. and Tarnocai, C. 1974. Soils and vegetation of hummocky terrain. Environmental-Social Program, Northern Pipelines, Rpt. No. 74-5. 86 pp.

APPENDIX

The appendix contains profile descriptions and analytical data for the remaining 36 soil sampling sites not described in the text. These profiles are arranged according to Great Groups, subgroups, parent materials, and, finally, chronogical (sampling date) order.

Site specific slopes classes are indicated. Lower case symbols signify complex slopes; upper case, simple or uniform slopes.

Additional general information on parent materials is given in Table 2 in the text.

Each site is indexed in the Table of Contents. Following is an index of the taxonomic arrangement and tabular information pertaining to the sampling sites contained in the appendix.

- Descriptions of profiles classed as Regosolic Static Cryosols, pages 127-130.
- Descriptions of the profiles classed as Brunisolic Static Cryosols, pages 131-136.
- Chemical and physical data for Regosolic and Brunisolic Static Cryosols, pages 137-138.
- Descriptions of profiles classed as Gleysolic Static Cryosols, pages 139-147.
- Chemical and physical data for Gleysolic Static Cryosols, pages 148-149.
- Descriptions of profiles classed as Fibric Organo Cryosols, pages 150-160.
- Chemical and physical data for Organo Cryosols, pages 161-162.
- Descriptions of profiles classes as Turbic Cryosols, pages 163-169.
- Chemical and physical data for Turbic Cryosols, pages 170-171.

Intensive Raised Beach Study Site - Plot 12G (See Fig. 1)

Sampling Date: July 9, 1971

Approximate Elevation and Age: 28 m AMSL; 7500 years B.P.

Slope Class and Aspect: c; raised beach crest

Drainage Class: Rapidly drained

Landform and Parent Material: Raised beach (crest zone); Bd 1 beach material

Vegetation: Cushion plant-lichen community (Muc and Bliss 1976)

Subgroup Class: Regosolic Static Cryosol (Pergelic Cryorthent)

Map Unit: Subdominant soil in map unit 11.

0-2 cm; poorly developed desert pavement; gravels and cobbles.

Ahk 2-13 cm; very dark brown (10 YR 2/2 m) gravelly sand; single grain; loose; plentiful, very fine and fine random roots; abrupt, smooth boundary; 11 ± 3 cm thick; mildly alkaline.

Ck 13-87 cm; very gravelly sand; single grain; loose; few, very fine roots to 56 cm; abrupt, smooth boundary; 74 ± 5 cm thick; moderately alkaline.

Cz 87 plus cm; frozen beach material.

Remarks: Sands, gravels, and some cobbles are randomly stratified throughout the profile. No matrix color is provided for the Ck horizon because individual grain colors prevail. Ck horizon is moist from 82 to 87 cm (immediately above the frost table).

Sampling Site 5. (See Fig. 2)

Approximate Elevation and Age: 12 m AMSL; 5700 years B.P.

Slope Class and Aspect: d; raised beach crest

Drainage Class: Rapidly drained

Landform and Parent Material: Raised beach (crest zone); Bd 1 beach material

Vegetation: Cushion plant-lichen community (Muc and Bliss 1976)

Subgroups Class: Regosolic Static Cryosol (Pergelic Cryorthent)

Map Unit: Subdominant soil in map unit 11.

0-2 cm; poorly developed desert pavement, mainly gravels.

Ck_1 2-7 cm; very dark grayish brown (10 YR 3/2 m) very gravelly loamy sand; single grain; loose; abundant, very fine and fine random roots; clear, broken boundary; 0-8 cm thick; moderately alkaline.

Ck_2 7-15 cm; dark brown (10 YR 3/3 m) very gravelly loamy sand; single grain; loose; few, very fine vertical roots; clear, wavy boundary; 5 to 7 cm thick; moderately alkaline.

Ck_3 15-83 cm; very gravelly loamy sand; single grain; loose; very few, very fine roots to 46 cm; abrupt, smooth boundary; 63 to 73 cm thick; moderately alkaline.

Cz 83 plus cm; frozen beach material.

Remarks: Random bedding of sands and gravels is not as apparent in this profile as in most others of raised beaches. There are a few cobbles throughout. The Ck_1 horizon has the color of Ahk horizon present on many other Regosolic Static Cryosols but lacks sufficient organic matter to meet the definition of an Ah horizon. There is no matrix color for the Ck_3 horizon as individual colors of sand and gravel grains predominate.

Sampling Site 16 (See Fig. 2)

Sampling Date: August 20, 1971

Approximate Elevation and Age: 8 m AMSL; 4400 years B.P.

Slope Class and Aspect: c; raised beach crest

Drainage Class: Rapidly drained.

Landform and Parent Material: Raised beach (crest zone); Bd 1 beach material.

Vegetation: Cushion plant-lichen community (Muc and Bliss 1976).

Subgroup Class: Regosolic Static Cryosol (Pergelic Cryorthent).

Map Unit: Subdominant soil in map unit 11.

0-2 cm; poorly developed desert pavement, mainly gravels.

Ahk 2-9 cm; very dark grayish brown (10 YR 3/2 m) very gravelly loamy sand; single grain; loose; plentiful, very fine and fine vertical roots; clear, smooth boundary; 6 to 8 cm thick; mildly alkaline.

Ck 9 plus cm; very gravelly sand; single grain; loose; plentiful, very fine and fine vertical roots to 26 cm; few, very fine vertical roots to 49 cm; moderately alkaline.

Remarks: This site is exposed along a stream-cut that crosses a raised beach. Consequently, the frost table is depressed and was not reached. Faint reddish coloration below 74 cm is probably associated with stream activity. Otherwise individual grain colors prevail and no matrix color exists (color not provided for Ck above). Sands and gravels are randomly bedded throughout the profile. Some cobbles occur throughout. Stones are concentrated along the stream-edge.

Sampling Site 33 (See Fig. 2)

Sampling Date: August 16, 1972

Approximate Elevation and Age: 65 m AMSL; 9000 years B.P.

Slope Class and Aspect: b; raised beach crest

Drainage Class: Rapidly drained

Landform and Parent Material: Raised beach (crest zone); Bd 1 beach material

Vegetation: Cushion plant-lichen community (Muc and Bliss 1976)

Subgroup Class: Regosolic Static Cryosol (Pergelic Cryorthent)

Map Unit: 21

0-2 cm; poorly developed desert pavement, cobbles and gravels.

Ahk 2-19 cm; very dark grayish brown (10 YR 3/2 m) very gravelly sand; single grain; loose; few, very fine and fine random roots to 11 cm; very few, very fine vertical roots to 19 cm; clear, smooth boundary; 15 to 18 cm thick; moderately alkaline.

Ck 19-80 cm; very gravelly sand; single grain; loose; very few, micro roots to 44 cm; moderately alkaline.

Cz 80 plus cm; frozen beach material.

Remarks: Cobble-size fragments (visually estimated at about 20%) occur throughout the profile. Sands and gravels are randomly stratified. No matrix color is provided for the Ck horizon because individual grain colors prevail.

Intensive Raised Beach Study Site - Plot 3 H (See Fig. 1)

Sampling Date: July 8, 1971

Approximate Elevation and Age: 28 m AMSL: 7500 years B.P.

Slope Class and Aspect: c; NNE (small depression)

Drainage Class: Well to moderately well drained

Landform and Parent Material: Raised beach (middle slope); Bd 1 beach material

Vegetation: Cushion plant-moss vegetation (Muc and Bliss 1976)

Subgroup Class: Brunisolic Static Cryosol (Pergelic Cryochrept)

Map Unit: Mapped as inclusion in map unit 11 but resembles soils of map unit 12.

LF 2-0 cm; black, partially decomposed plant litter; 0-4 cm thick.

Ah 0-5 cm; blck (10 YR 2/1 m) gravelly sandy loam; single grain; very friable; abundant, very fine and fine roots; clear, smooth boundary; 4 to 7 cm thick; neutral.

Bmk 5-15 cm; very dark brown (10 YR 2/2 m) gravelly sand; single grain; loose; plentiful, very fine and fine roots; abrupt, smooth boundary; 8 to 12 cm thick; mildly alkaline.

Ck_1 15-28 cm; dark brown (10 YR 3/3 m) gravelly sand; single grain; loose; few, very fine roots; clear, smooth boundary; 11 to 15 cm thick; mildly alkaline.

Ck_2 28-61 cm; dark yellowish brown (10 YR 3/4 m) sand; single grain; loose; very few, very fine roots; abrupt, smooth boundary; 30 to 36 cm thick; mildly alkaline.

Cz 61 plus cm; frozen beach material.

Remarks: Ck horizon are much more uniformily and darkly colored than most others in beach material. There are a few cobbles throughout this profile. Free water (melt-water) occurs between 47 and 61 cm. Such a depth of free water reflects the season (early summer) in which this site was examined.

Sampling Site 3 (See Fig. 2)

Sampling Date: July 27, 1971

Approximate Elevation and Age: 11 m AMSL; 5700 years B.P.

Slope Class and Aspect: c; NNW

Drainage Class: Moderately well drained

Landform and Parent Material: Raised beach (lower slope); Bd 1 beach material

Vegetation: Cushion plant-moss community (Muc and Bliss 1976)

Subgroup Class: Brunisolic Static Cryosol (Pergelic Cryochrept)

Map Unit: Mapped as and inclusion in map unit 11 but soil belongs to map unit 12.

LF 3-0 cm; black, partially decomposed plant litter; 0-4 cm thick.

Ahk 0-10cm; black to very dark brown (10 YR 2/1 - 2/2 m) gravelly sand; single grain; very friable; plentiful, very fine and fine random roots; abrupt, wavy boundary; 5 to 15 cm thick; mildly alkaline.

Bmk 10-23 cm; very dark grayish brown (10 YR 3/2 m) gravelly sand; single grain; loose; few, very fine vertical roots; clear, wavy boundary; 8 to 18 cm thick; moderately alkaline.

Ck_1 23-26 cm; dark brown (10 YR 3/3 m) loamy sand; single grain; loose; very few, very fine roots; abrupt, smooth boundary; 8 to 13 cm thick; moderately alkaline.

Ck_2 46-54 cm; brown to dark brown (10 YR 4/3 m) sand; single grain; nonsticky, nonplastic; abrupt, smooth boundary; 5 to 10 cm thick; moderately alkaline.

Cz 54 plus cm; frozen beach material.

Remarks: This profile displays a more ordered stratification of materials than will commonly be found in raised beaches. Free water (probably lateral flowing melt-water) occurs in the Ck_2 horizon above the frost table.

Sampling Site 10 (See Fig. 2)

Sampling Date: July 31, 1971

Approximate Elevation and Age: 20 m AMSL; 6700 years B.P.

Slope Class and Aspect: C; NW

Drainage Class: Moderately well drained

Landform and Parent Material: Raised beach (lower slope); Bd 1 beach material

Vegetation: Cushion plant-moss community (Muc and Bliss 1976)

Subgroup Class: Brunisolic Static Cryosol (Pergelic Cryochrept)

Map Unit: 12

LF 2-0 cm; black, partially decomposed plant litter; 1-5 cm thick.

Ahk 0-13 cm; black (10 YR 2/1 m) gravelly sandy loam; single grain; very friable; plentiful, very fine and fine roots; abrupt, wavy boundary; 9 to 24 cm thick; neutral.

Bmk 13-28 cm; dark brown (10 YR 3/3 m) gravelly sand; single grain; loose; few, very fine roots; clear, smooth boundary; 14 to 24 cm thick; mildly alkaline.

Ck 28-62 cm; brown (10 YR 4/3 m) gravelly sand; single grain; loose; very few, very fine roots to 48 cm; abrupt, smooth boundary; 30 to 37 cm thick; mildly alkaline.

Cz 62 plus cm; frozen beach material.

Remarks: The significant variation in thickness of the Ahk horizon is due, in part, to the micro-hummocky ground surface. Two, faint, discontinuous, very dark brown (10 YR 2/2 m) bands occur in the Bmk horizon. The Ck horizon is quite stony below 38 cm and very moist below 57 cm. The color given for the Ck horizon is only approximate.

Sampling Site 17 (See Fig. 2)

Sampling Date: August 20, 1971

Approximate Elevation and Age: 8 m AMSL; 4400 years B.P.

Slope Class and Aspect: C; ESE

Drainage Class: Well to moderately well drained

Landform and Parent Material: Raised beach (middle to lower slope); Bd 1 beach material

Vegetation: Cushion plant-moss community (Muc and Bliss 1976)

Subgroup Class: Brunisolic Static Cryosol (Pergelic Cryochrept)

Map Unit: Mapped as an inclusion in map unit 11 but soil belongs to map unit 12.

LF 2-0 cm; black, partially decomposed plant litter; 0 to 3 cm thick.

Ahk 0-8 cm; very dark brown (10 YR 2/2 m) gravelly loamy sand; single grain; very friable; plentiful, very fine and fine roots; abrupt, smooth boundary; 6 to 9 cm thick; mildly alkaline.

Bmk 8-15 cm; very dark grayish brown to dark brown (10 YR 3/2 - 3/3 m) very gravelly sand; single grain; loose; plentiful, very fine roots; clear, smooth boundary; 5 to 9 cm thick; moderately alkaline.

Ck 15 plus cm; very gravelly sand; single grain; loose; few, very fine roots to 38 cm; moderately alkaline.

Remarks: This site is exposed along a stream-cut that crosses a raised beach. Consequently, the frost table is depressed and was not reached. Faint reddish coloration below 51 cm is probably associated with stream activity. A matrix color is not provided for the Ck horizon because individual grain colors prevail. Sands and gravels are randomly bedded throughout the profile. Some cobbles occur throughout. Stones are concentrated along the stream-edge.

Sampling Site 20 (See Fig. 2)

Sampling Date: July 28, 1972

Approximate Elevation and Age: 25 m AMSL; 7800 years B.P.

Slope Class and Aspect: d; S

Drainage Class: Well drained

Landform and Parent Material: Beach veneer over crystalline becrock; Bd 2 beach material

Vegetation: Cushion plant-moss community (Muc and Bliss 1976)

Subgroup Class: Brunisolic Static Cryosol (Pergelic Cryochrept)

Map Unit: 13

LF 2-0 cm; black, partially decomposed plant litter; 0-3 cm thick.

Ah 0-10 cm; black (10 YR 2/1 m) very gravelly sandy loam; single grain; very friable; plentiful, very fine and fine oblique roots; abrupt, smooth boundary; 8 to 12 cm thick; neutral.

Bm 10-18 cm; very dark brown (10 YR 2/2 m) gravelly sand; single grain; loose; few, very fine and fine roots; gradual, smooth boundary; 7 to 9 cm thick; neutral.

C_1 18-28 cm; dark yellowish brown (10 YR 3/4 m) very gravelly sand; single grain; loose; few, very fine roots; abrupt, smooth boundary; 9 to 11 cm thick; mildly alkaline.

C_2 28-41 cm; very gravelly sand; single grain; loose; mixture of sands, gravels, and cobbles; 30-50% coarse fragments (visual estimate); abrupt, smooth boundary; 11 to 16 cm thick.

Cz 41 plus cm; frozen beach material.

Remarks: The Bm and C_1 horizons are developed in well-sorted (fine gravels and coarse sand) beach material. There is no uniform matrix color for the C_2 horizon. This material (Bd 2) has a very high content of crystalline fragments compared to other beach materials.

Sampling Site 26 (See Fig. 2)

Sampling Date: August 1, 1972

Approximate Elevation and Age: 37 m AMSL; 8000 years B.P.

Slope Class and Aspect: E; NW

Drainage Class: Moderately well to imperfectly drained

Landform and Parent Material: Short raised beach between two crystalline rock outcrops; Bd 2 beach material

Vegetation: Cushion plant-moss community (Muc and Bliss 1976)

Subgroup Class: Brunisolic Static Cryosol.

Map Unit: Mapped as map unit 12 based on site features; soil does not fit any of the map unit concepts.

LF 13-10 cm; black, partially decomposed plant litter; 2 to 4 cm thick.

FH 10-0 cm; black (10 YR 2/1 m) fairly well humified organic material; abundant, very fine and fine random roots; clear, wavy boundary; 5-15 cm thick; slightly acid.

Ah 0-18 cm; black to very dark brown (10 YR 2/1 - 2/2 m) very gravelly sand; single grain; very friable; plentiful, very fine and fine random roots; clear, wavy boundary; 13 to 25 cm thick; neutral.

Bm 18-25 cm; very dark grayish brown (10 YR 3/2 m) very gravelly sand; single grain; loose; very few, very fine roots; abrupt, broken boundary; 0-12 cm thick; neutral.

Bz 25 plus cm; frozen sands and gravels; includes some frozen Ah horizon on up-slope side of pit.

Remarks: This individual is much deeper and contains more organic matter than modal soils of map unit 12. Slightly acid to neutral reactions, lack of carbonates, and a high content of crystalline coarse fragments identify the geologic material as Bd 2 (Table 2). However, at this site the deposit is substantially thicker than is commonly found. Site characteristics (landform, vegetation, and drainage) resemble those of map unit 12. There are few cobbles and staones in this profile.

Table A1. Chemical and physical data for Regosolic and Brunisolic Static Cryosols

Horizon	Depth (cm)	pH	Org. Carbon %	Total N %	$CaCO_3$ Equiv. %	Exchangeable Cations (me/100g)					T.E.C. (me/100g)	Available Nutrients (ppm)					Oxalate		% Coarse Fragments (>2mm)	Particle Size Distribution (% of <2mm fraction)			Bulk Density (gm/cc)
						H	Ca	Mg	Na	K		NO_3-N	P	K	Na	SO_4-S	Fe %	Al %		Sand (2.0 - 0.05mm)	Silt (0.05 - 0.002mm)	Clay (<0.002 mm)	
Intensive Raised Beach Study Site (Plot 12G) -- Regosolic Static Cryosol in Bd 1 beach material:																							
Ahk	2-13	7.8	1.0	0.07	11.2	-	-	-	-	-	-	2	2	11	2	1.0	0.11	0.01	47	93	7	0	1.4
Ck	13-26	8.0	0.0	0.02	12.9	-	-	-	-	-	-	0	5	5	1	1.0	0.09	0.00	50	91	7	2	1.7
Ck	26-56	8.0	0.0	0.01	16.3	-	-	-	-	-	-	0	4	3	1	0.5	0.06	0.00	74	93	7	0	1.7
Ck	56-87	7.7	0.4	0.00	11.6	-	-	-	-	-	-	0	2	4	1	0.5	Tr	0.00	-	95	5	0	-
Site 5 -- Regosolic Static Cryosol in Bd 1 beach material:																							
Ck_1	2-7	7.9	0.3	0.20	37.8	-	-	-	-	-	-	6	2	23	2	1.5	-	-	66	77	18	5	1.5
Ck_2	7-15	8.1	0.1	0.06	38.8	-	-	-	-	-	-	0	1	9	1	1.5	-	-	67	81	17	2	1.6
Ck_3	15-83	8.4	0.0	0.00	34.3	-	-	-	-	-	-	0	1	5	1	1.5	-	-	77	84	15	1	1.8
Site 16 -- Regosolic Static Cryosol in Bd 1 beach material:																							
Ahk	2-9	7.8	1.5	0.10	39.9	-	-	-	-	-	-	0	1	21	2	1.5	-	-	55	80	18	2	1.4
Ck	9+	8.0	0.0	0.01	32.8	-	-	-	-	-	-	0	2	7	1	1.0	-	-	71	94	6	0	1.8
Site 33 -- Regosolic Static Cryosol in Bd 1 beach material:																							
Ahk	2-19	7.9	1.6	0.10	6.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88	7	5	-
Ck	19-80	8.2	-	-	16.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	94	2	4	-
Intensive Raised Beach Study Site (Plot 3H) -- Brunisolic Static Cryosol in Bd 1 beach material:																							
Ah	0-5	7.2	12.5	1.43	0.7	-	68.2	23.3	0.2	0.6	79.7	62	8	192	10	8.8	-	-	21	73	14	13	0.4
Bmk	5-15	7.6	1.8	0.09	4.3	-	-	-	-	-	-	1	1	10	1	1.5	-	-	43	89	11	0	1.3
Ck_1	15-28	7.7	1.5	0.06	7.0	-	-	-	-	-	-	0	1	7	2	2.0	-	-	47	92	8	0	1.5
Ck_2	28-61	7.7	1.2	0.02	3.8	-	-	-	-	-	-	0	1	4	1	1.0	-	-	14	96	4	0	1.4

Table A1. Continued

Horizon	Depth (cm)	pH	Org. Carbon %	Total N %	$CaCO_3$ Equiv. %	Exchangeable Cations (me/100g)					T.E.C. (me/100g)	Available Nutrients (ppm)					Oxalate		% Coarse Fragments (>2mm)	Particle Size Distribution (% of <2mm fraction)			Bulk Density (gm/cc)
						H	Ca	Mg	Na	K		NO_3-N	P	K	Na	SO_4-S	Fe %	Al %		Sand (2.0 - 0.05mm)	Silt (0.05 - 0.002mm)	Clay (<0.002 mm)	
Site 3 -- Brunisolic Static Cryosol in Bd 1 beach material:																							
Ahk	0–10	7.5	5.7	0.36	9.4	-	21.9	7.1	0.1	0.1	24.5	7	0	23	4	3.8	-	-	42	89	9	2	1.2
Bmk	10–23	7.9	1.5	0.09	10.6	-	-	-	-	-	-	0	0	9	1	1.0	-	-	37	94	3	3	1.5
Ck_1	23–46	8.1	0.0	0.02	21.5	-	-	-	-	-	-	0	1	6	1	1.0	-	-	18	85	13	2	1.5
Ck_2	46–54	8.2	0.2	0.01	16.8	-	-	-	-	-	-	0	1	7	2	2.9	-	-	5	92	6	2	1.4
Site 10 -- Brunisolic Static Cryosol in Bd 1 beach material:																							
Ahk	0–13	7.1	16.8	1.02	4.6	-	59.6	18.1	0.2	0.1	65.4	12	0	42	10	4.0	0.40	0.06	-	67	29	4	-
Bmk	13–28	7.7	1.0	0.17	10.3	-	-	-	-	-	-	1	1	8	3	2.6	0.07	0.00	-	96	4	0	-
Ck	28–62	7.8	0.1	0.02	19.3	-	-	-	-	-	-	1	2	8	2	3.5	0.19	0.00	-	92	8	0	-
Site 17 -- Brunisolic Static Cryosol in Bd 1 beach material:																							
Ahk	0–8	7.5	10.6	0.89	7.2	-	52.9	16.5	0.1	1.4	58.2	56	2	531	11	4.8	-	-	29	79	12	9	0.6
Bmk	8–15	7.9	2.5	0.18	29.7	-	-	-	-	-	-	6	0	18	3	2.6	-	-	65	89	6	5	1.5
Ck	15+	7.9	0.0	0.01	30.8	-	-	-	-	-	-	1	3	8	2	4.8	-	-	75	90	5	5	1.8
Site 20 -- Brunisolic Static Cryosol in Bd 2 beach material:																							
Ah	0–10	6.6	7.9	0.65	-	-	27.5	9.6	0.1	0.2	42.3	-	-	-	-	-	0.65	0.08	80	67	23	10	1.2
Bm	10–18	7.1	0.5	0.08	0.2	-	1.6	0.9	Tr	Tr	3.4	-	-	-	-	-	0.16	0.01	40	96	2	2	1.3
C_1	18–28	7.4	-	-	0.2	-	0.9	0.6	Tr	Tr	1.6	-	-	-	-	-	0.26	0.01	60	96	2	2	1.4
Site 26 -- Brunisolic Static Cryosol in Bd 2 beach material:																							
FH	10–0	6.3	41.5	2.58	-	18.6	104.7	31.8	0.3	0.6	151.7	-	-	-	-	-	-	-	18	-	-	-	0.2
Ah	0–18	6.6	6.3	0.56	-	-	31.0	9.3	0.4	0.1	42.7	-	-	-	-	-	-	-	88	88	9	3	1.3
Bm	18–25	6.9	-	-	-	-	3.1	1.2	Tr	Tr	4.9	-	-	-	-	-	-	-	63	92	3	5	1.5

Sampling Site 40 (See Fig. 2)

Sampling Date: July 9, 1971

Approximate Elevation and Age: 28 m AMSL; 7500 years B.P.

Slope Class and Aspect: C; NE

Drainage Class: Imperfectly to poorly drained

Landform and Parent Material: Undifferentiated plain but marginal to a raised beach; undifferentiated (Un) material.

Vegetation: Hummocky sedge-moss meadow transitional to cushion plant-moss community (Muc and Bliss 1976)

Subgroup Class: Gleysolic Static Cryosol or "gleyed" Brunisolic Static Cryosol

Map Unit: 31

8-5 cm; moss layer.

Om 5-0 cm; black (10 YR 2/1 m) partially humified organic matter; abundant, very fine and fine roots; abrupt, wavy boundary; 3 to 7 cm thick; neutral.

Bkg 0-25 cm; dark brown to brown (7.5 YR 4/4 m) sandy loam; massive; very friable; few, faint mottles; plentiful very fine and fine roots; clear, smooth boundary; 22 to 27 cm thick; mildly alkaline.

Ckg 25-36 cm; dark brown to brown (10 YR 4/3 m) sandy loam; pockets with concentration of organic matter; single grain; very friable; few very fine and fine roots; abrupt, smooth boundary; 9 to 13 cm thick; mildly alkaline.

Cz 36 plus cm; frozen undifferentiated material.

Remarks: This soil individual is quite unique among soils of the study area. It is the only profile that morphologically resembles Upland Tundra soils (Tedrow *et al.* 1958). The slightly reddish color of the Bg horizon is also unique. Classification of this profile in the Cryosolic Order is difficult; in the American system (7th Approximation), was not attempted.

Sampling Site 7 (See Fig. 2)

Sampling Date: July 28, 1971

Approximate Elevation and Age: 18 m AMSL; 6500 years B.P.

Slope Class and Aspect: B;W

Drainage Class: Very poorly drained

Landform and Parent Material: Undifferentiated plain; undifferentiated (Un) material

Vegetation: Hummocky sedge-moss meadow (Muc and Bliss 1976)

Subgroup Class: Gleysolic Static Cryosol (Pergelic Cryaquept)

Map Unit: 31

8-0 cm; moss layer

Ahkg 0-9 cm; black to very dark brown (10 YR 2/1 - 2/2 m) sandy loam enriched with fibrous organic matter; abundant, very fine and fine vertical roots; abrupt, smooth boundary; 5 to 10 cm thick; mildly alkaline.

Ckg 9-47 cm; very dark grayish brown to dark grayish brown (2.5 Y 3/0 - 4/0 m) samdy loam; slightly sticky, nonplastic; plentiful, very fine roots to 19 cm; abrupt, smooth boundary; 35 to 40 cm thick; moderately alkaline.

Cz 47 plus cm; frozen undifferentiated material

Remarks: The Ahkg horizon resembles Of horizons of other Gleysolic Static Cryosols in map unit 31. However, the low organic matter content (see Table A2) did not meet the requirements for an organic horizon. The variability in thickness of the Ahkg horizon is due to hummocky micro-relief.

Intensive Meadow Study Site - Plot 14 G (See Fig. 1)

Sampling Date: August 17, 1971

Approximate Elevation and Age: 35 m AMSL; <8000 years B.P.

Slope Class and Aspect: B-C; W

Drainage Class: Very poorly drained

Landform and Parent Material: Undifferentiated plain; undifferentiated (Un) material

Vegetation: Hummocky sedge-moss meadow (Muc and Bliss 1976)

Subgroup Class: Gleysolic Static Cryosol (Histic Pergelic Cryaquept)

Map Unit: 71

30-27 cm; moss layer.

Of 27-0 cm; dark reddish brown (5 YR 2/2 m) fibrous organic matter; contains some in-washed sands; abundant, very fine and fine random roots; abrupt, smooth boundary; 23 to 30 cm thick; medium acid.

Cg 0-3 cm; dark grayish brown (2.5 Y 4/2 m) sand; abrupt, smooth boundary; 2 to 4 cm thick; slightly acid.

Cz 3 plus cm; frozen sand.

Remarks: The slightly acid, noncalcareous, well-sorted sand is not characteristic of undifferentiated (Un) material normally associated with such soils. The mineral material at this site is probably of alluvial origin. This soil is an inclusion in a soil area (map unit 71) dominated by organic soils.

Sampling Site 21 (See Fig. 2)

Sampling Date: July 28, 1972

Approximate Elevation and Age: 35 m AMSL; 7800 years B.P.

Slope Class and Aspect: B; WNW

Drainage Class: Poorly drained

Landform and Parent Material: Undifferentiated plain; undifferentiated (Un) material

Vegetation: Hummocky sedge-moss meadow (Muc and Bliss 1976)

Subgroup Class: Gleysolic Static Cryosol (Histic Pergelic Cryaquept)

Map Unit: 31

17-13 cm; moss layer.

Of 13-0 cm; black to very dark brown (10 YR 2/1 - 2/2 m) fibrous organic matter; abundant, very fine and fine vertical roots; abrupt, smooth boundary; 12 to 15 cm thick; neutral.

Ckg 0-33 cm; dark grayish brown to olive brown (2.5 Y 4/2 - 4/4 m) sandy loam; slightly sticky; nonplastic; abrupt, smooth boundary; 30 to 36 cm thick; moderately alkaline.

Cz 33 plus cm; frozen undifferentiated material.

Remarks: This site occurs in a small meadow at the top of a large crystalline rock outcrop. The mineral layer is quite typical of undifferentiated material but contains about 50% cobbles and stones. The Of has less than 10% cobbles with a higher concentration nearer the lower boundary. The meadow is quite stony, especially near its edges. Because it is associated with a rock outcrop (therefore warmer temperatures), this soil has an unusually deep active layer.

Sampling Site 24 (See Fig. 2)

Sampling Date: July 31, 1972

Approximate Elevation and Age: 20 m AMSL; 7000 years B.P.

Slope Class and Aspect: B; SW

Drainage Class: Poorly drained

Landform and Parent Material: Undifferentiated plain; undifferentiated (Un) material.

Vegetation: Hummocky sedge-moss meadow (Muc and Bliss 1976)

Subgroup Class: Gleysolic Static Cryosol (Histic Pergelic Cryaquept)

Map Unit: 31

15-10 cm; moss layer

Of 10-0 cm; very dark brown (10 YR 2/2 m) fibrous organic matter; abundant, very fine to medium roots; abrupt, irregular boundary; 8 to 18 cm thick; neutral.

Ckg 0-18 cm; olive brown (2.5 Y 4/4 m) sandy loam to loamy sand; common, medium, faint, very dark grayish brown (w.5 Y 3/2 m) mottles; nonsticky, nonplastic; abundant, very fine and fine roots; 20% gravels, less than 5% cobbles; abrupt, smooth boundary; 10 to 21 cm thick; mildly alkaline.

Cz 18 plus cm; frozen undifferentiated material.

Remarks: Except for color, mottling, and organic matter (see Table A2) in the Ckg horizon, this soil is typical of Gleysolic Static Cryosols in map units 31 and 71.

Sampling Site 15 (See Fig. 2)

Sampling Date: August 19, 1971

Approximate Elevation and Age: 25 m AMSL; <9000 years B.P.

Slope Class and Aspect: A-B; W

Drainage Class: Very poorly drained

Landform and Parent Material: Alluvial-lacustrine plain; alluvial-lacustrine (As) material

Vegetation: Wet sedge-moss meadow (Muc and Bliss 1976)

Subgroup Class: Gleysolic Static Cryosol (Histic Pergelic Cryaquept)

Map Unit: 32

13-10 cm; moss layer

Of 10-0 cm; dark reddish brown (5 YR 2/2 m) fibrous organic matter; abundant, very fine and fine roots; abrupt smooth boundary; 8 to 12 cm thick; slightly acid.

Ahg_1 0-6 cm; dark gray (2.5 Y 4/0 m) clay; massive; sticky, slightly plastic; abundant, very fine and fine roots; clear, wavy boundary; 4 to 9 cm thick; neutral.

Ahg_2 6-18 cm; very dark grayish brown (2.5 Y 3/2 m) silty clay; massive; slightly sticky, nonplastic; plentiful, very fine roots; abrupt, smooth boundary; 9 to 15 cm thick; neutral.

Ahz 18 plus cm; frozen alluvial-lacustrine and organic materials.

Remarks: This profile definitely shows cumulization. The organic matter in the Ahg horizons (in particular, the Ahg_2 horizon) is very fibrous and has the appearance of having trapped the mineral material.

Sampling Site 25 (See Fig. 2)

Sampling Date: August 1, 1972

Approximate Elevation and Age: 25 m AMSL; <8000 years B.P.

Slope Class and Aspect: b; ESE

Drainage Class: Poorly drained

Landform and Parent Material: Alluvial-lacustrine plain; alluvial-lacustrine (As) material

Vegetation: Hummocky sedge-moss meadow (Muc and Bliss 1976)

Subgroup Class: Gleysolic Static Cryosol (Histic Pergelic Cryaquept)

Map Unit: 32

12-8 cm; moss layer.

Of 8-0 cm; very dark brown (10 YR 2/2 m) fibrous organic matter; abundant, very fine to medium random roots; abrupt, smooth boundary; 6 to 10 cm thick; slightly acid.

Ahg 0-5 cm; very dark grayish brown (10 YR 3/2 m) clay loam; massive; slightly sticky, slightly plastic; plentiful, very fine and fine roots; abrupt, smooth boundary; 4 to 6 cm thick; medium acid.

Ahz 5 plus cm; frozen alluvial-lacustrine plus organic materials

Remarks: A discontinuous band, about 2 cm thick, of dark reddish brown (5 YR 2/2 m) organic matter occurs at the top of the Of horizon. Small, infrequent pockets of in-washed sand occur at the lower boundary of the Of horizon. Organic matter in the Ahg horizon is partially humified as it lacks the high content of fibres that typifies the Of horizon.

Sampling Site 27 (See Fig. 2)

Sampling Date: August 1, 1972

Approximate Elevation and Age: 25 m AMSL; <8000 years B.P.

Slope Class and Aspect: A; Level

Drainage Class: Very poorly drained

Landform and Parent Material: Alluvial-lacustrine plain; alluvial-lacustrine (As) material

Vegetation: Wet sedge-moss meadow (Muc and Bliss 1976)

Subgroup Class: Gleysolic Static Cryosol (Histic Pergelic Cryaquept)

Map Unit: 32; marginal to 31.

14-10 cm; moss layer

Of 10-0 cm; very dark brown (10 YR 2/2 m) fibrous organic matter; abundant, very fine and fine roots; clear, smooth boundary; 10 to 13 cm thick; medium acid.

Cg 0-4 cm; olive (5 Y 4/3 m) sandy loam; olive brown (2.5 Y 4/4 m) near top; massive; slightly sticky, nonplastic; abundant very fine and fine random roots; abrupt, wavy boundary; 4 to 10 cm thick; medium acid.

Cz 4 plus cm; frozen alluvial-lacustrine material.

Remarks: Reaction and landscape position indicate that this individual be included with soils of map unit 32. Texture and low organic matter content of the Cg horizon are more characteristic of gleyed mineral soils of map unit 31. Consequently, this individual is considered as being marginal (or transitional) between modal soils of both units.

Sampling Site 30 (See Fig. 2)

Sampling Date: August 11, 1972

Approximate Elevation and Age: 35 m AMSL; 8000 years B.P.

Slope Class and Aspect: C; SSW

Drainage Class: Poorly drained

Landform and Parent Material: Alluvial-lacustrine plain; alluvial-lacustrine (As) material

Vegetation: Hummocky sedge-moss meadow (Muc and Bliss 1976)

Subgroup Class: Gleysolic Static Cryosol (Histic Pergelic Cryaquept)

Map Unit: 32

3-0 cm; moss layer.

Ahg_1 0-10 cm; very dark brown (10 YR 2/2 m) loam enriched with fibrous organic matter; abundant, very fine and fine roots; abrupt, smooth boundary; 9 to 12 cm thick; neutral.

Ahg_2 10-18 cm; dark grayish brown (2.5 Y 4/2 m) clay loam; massive; sticky; slightly plastic; plentiful, very fine and fine random roots; abrupt, wavy boundary; 6 to 11 cm thick; mildly alkaline.

Ahkbg 18-25 cm; black (10 YR 2/1 m) loam; massive; slightly sticky, non-plastic; few, very fine and fine roots; abrupt, smooth boundary; 5 to 9 cm thick.

Ahz 25 plus cm; frozen alluvial-lacustrine and organic materials.

Remarks: The Ahg_1 horizon resembles Of horizons of other Gleysolic Static Cryosols but contains insufficient organic matter to meet the definition of an organic horizon. Organic matter is partially humified in the Ahkbg horizon and lacks the fibrous appearance of the overlying horizons. This soil has a higher reaction and more carbonate than is typical of alluvial-lacustrine rine soils in map unit 32.

Table A2. Chemical and physical data for Cleysolic Static Cryosols

Horizon	Depth (cm)	pH	Org. Carbon %	Total N %	$CaCO_3$ Equiv. %	Exchangeable Cations (me/100g)					T.E.C. (me/100g)	Available Nutrients (ppm)					Oxalate		% Coarse Fragments (>2mm)	Particle Size Distribution (% of <2mm fraction)			Bulk Density (gm/cc)
						H	Ca	Mg	Na	K		NO_3-N	P	K	Na	SO_4-S	Fe %	Al %		Sand (2.0 - 0.05mm)	Silt (0.05 - 0.002mm)	Clay (<0.002 mm)	
Site 40 -- Cleysolic Static Cryosol in undifferentiated material:																							
Om	5-0	6.8	38.9	2.15	-	-	98.8	34.3	0.4	1.7	137.9	3	33	703	30	10.1	0.16	0.00	-	-	-	-	-
Bkg	0-25	7.8	1.9	0.09	5.8	-	-	-	-	-	-	1	0	15	1	2.0	0.76	0.06	-	70	20	10	-
Ckg	25-36	7.7	2.3	0.16	9.0	-	-	-	-	-	-	0	0	13	2	2.9	0.74	0.05	-	74	18	8	-
Site 7 -- Cleysolic Static Cryosol in undifferentiated material:																							
Ahkg	0-9	7.4	13.5	1.19	3.2	-	54.3	15.5	0.2	0.2	60.8	6	2	61	14	15.0	0.52	0.07	-	-	-	-	-
Ckg	9-47	8.0	0.6	0.05	23.5	-	-	-	-	-	-	1	0	31	2	4.6	0.31	0.02	-	66	23	11	-
Intensive Meadow Study Site (Plot 14G) -- Cleysolic Static Cryosol in undifferentiated material:																							
Of	27-0	6.0	34.9	2.37	-	21.3	119.6	17.5	0.4	0.1	91.7	0	0	23	20	27.4	0.45	0.16	-	-	-	-	-
Cg	0-3	6.2	0.5	0.08	-	1.2	5.5	1.0	Tr	Tr	3.6	0	0	2	1	15.4	0.03	0.00	-	92	5	3	-
Site 21 -- Gleysolic Static Cryosol in undifferentiated material:																							
Of	13-0	6.6	34.0	2.93	-	-	86.7	15.3	0.2	0.3	111.4	-	-	-	-	-	-	-	-	-	-	-	-
Ckg	0-33	8.0	-	-	14.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	68	24	8	-
Site 24 -- Cleysolic Static Cryosol in undifferentiated material:																							
Of	10-0	6.7	23.8	2.06	-	-	54.6	18.8	0.5	0.3	87.7	-	-	-	-	-	1.10	0.07	-	-	-	-	-
Ckg	0-18	7.7	1.3	0.09	11.8	-	-	-	-	-	-	-	-	-	-	-	0.76	0.01	-	78	14	8	-
Site 15 -- Cleysolic Static Cryosol in alluvial-lacustrine material:																							
Of	10-0	6.3	40.1	1.86	-	18.8	76.4	21.9	0.2	0.4	102.8	0	0	115	25	22.3	0.39	0.16	-	-	-	-	-
Ahg_1	0-6	6.6	7.8	0.51	-	-	24.8	9.5	0.1	0.3	31.5	0	1	93	5	23.7	0.30	0.05	-	9	36	55	-
Ahg_2	6-18	6.6	11.1	0.68	-	-	25.6	8.9	0.1	0.3	35.6	0	0	92	4	16.0	0.47	0.18	-	12	43	45	-

Table A2. Continued

Horizon	Depth (cm)	pH	Org. Carbon %	Total N %	CaCO₃ Equiv. %	Exchangeable Cations (me/100g)					T.E.C. (me/100g)	Available Nutrients (ppm)					Oxalate		% Coarse Fragments (>2mm)	Particle Size Distribution (% of <2mm fraction)			Bulk Density (gm/cc)
						H	Ca	Mg	Na	K		NO_3-N	P	K	Na	SO_4-S	Fe %	Al %		Sand (2.0 - 0.05mm)	Silt (0.05 - 0.002mm)	Clay (<0.002 mm)	
Site 25 -- Gleysolic Static Cryosol in alluvial-lacustrine material:																							
Of	8-0	6.1	29.0	2.26	-	27.0	34.0	12.3	0.1	0.3	82.2	-	-	-	-	-	2.45	0.12	-	-	-	-	-
Ahg	0-5	5.7	10.3	0.86	-	14.4	7.9	3.0	Tr	0.1	35.2	-	-	-	-	-	1.47	0.13	-	22	39	39	-
Site 27 -- Gleysolic Static Cryosol in alluvial-lacustrine material:																							
Of	10-0	5.8	32.0	2.24	-	28.5	40.3	14.4	0.3	0.3	93.8	-	-	-	-	-	1.91	0.07	-	-	-	-	-
Cg	0-4	5.6	-	-	-	3.2	1.7	0.9	0.1	0.1	6.8	-	-	-	-	-	0.55	0.03	-	64	18	18	-
Site 30 -- Gleysolic Static Cryosol in alluvial-lacustrine material:																							
Ahg_1	0-10	7.3	13.3	1.33	1.0	-	45.3	14.8	Tr	0.5	58.2	-	-	-	-	-	1.35	0.04	-	-	-	-	-
Ahg_2	10-18	7.5	3.1	0.18	0.5	-	9.9	4.6	0.1	0.3	13.8	-	-	-	-	-	0.32	0.02	-	36	32	32	-
Ahkbg	18-25	7.4	8.4	0.80	3.1	-	27.2	8.9	Tr	0.3	36.5	-	-	-	-	-	0.81	0.02	-	45	29	26	-

Intensive Meadow Study Site - Plot 1La (See Fig. 1)

Sampling Date: July 29, 1971

Approximate Elevation and Age: 35 m AMSL; <8000 years B.P.

Slope Class and Aspect: C; WNW

Drainage Class: Very poorly drained

Parent Material: Slightly decomposed sedges and mosses

Vegetation: Hummocky sedge-moss meadow (Muc and Bliss 1976)

Subgroup Class: Fibric Organo Cryosol (Pergelic Cryofibrist)

Map Unit: 71

3-0 cm; moss layer

Of 0-9 cm; very dark brown (10 YR 2/2 m) fibrous organic matter; abundant, very fine and fine roots; clear, smooth boundary; 8 to 10 cm thick; slightly acid.

Ahg 9-21 cm; dark brown (10 YR 3/3 m) coarse sand in a fibrous organic matter matrix; sand is in-washed and occurs in pockets and bands; abundant, very fine and fine roots; abrupt, smooth boundary; 10 to 13 cm thick; slightly acid.

Ahz 21 plus cm; frozen sand and organic material.

Remarks: This site occurs in an inter-hummock depression adjacent to the profile from Intensive Meadow Study Site - Plot 1Lb (hummock position) on the following page. In-washed sand in this profile is thought to be of alluvial origin because the site occurs in a micro-alluvial fan position just below a small, temporary stream. Small lenses and bands of sand also occur in the Of horizon.

Intensive Meadow Study Site - Plot 1Lb (See Fig. 1)

Sampling Date: July 29th, 1971

Approximate Elevation adn Age: 35 m AMSL; <8000 years B.P.

Slope Class and Aspect: C; WNW

Drainage Class: Very poorly drained

Parent Material: Slightly decomposed sedges and mosses

Vegetation: Hummocky sedge-moss meadow (Muc and Bliss 1976)

Subgroup Class: Fibric Organo Cryosol (Pergelic Cryofibrist)

Map Unit: 71

6-0 cm; moss layer

Of_1 0-9 cm; very dark brown (10 YR 2/2 m) fibrous organic matter; abundant, very fine and fine roots; clear; smooth boundary; 8 to 10 cm thick; slightly acid.

Ahg 9-24 cm; dark brown (10 YR 3/3 m) coarse sand in a fibrous organic matter matrix; sand is in-washed and occurs in pockets and bands; abundant, very fine and fine roots; abrupt, smooth boundary; 13 to 17 cm thick; slightly acid.

Of_2 24-27 cm; very dark brown (10 YR 2/2 m) fibrous organic matter; abundant, very fine and fine roots; abrupt, smooth boundary; 2 to 4 cm thick; slightly acid.

Oz 27 plus cm; frozen organic material.

Remarks: This site occurs in a hummock adjacent to the profile from Intensive Meadow Study Site - Plot 1La (inter-hummock depression) on the preceding page. In-washed sand in this profile is thought to be of alluvial origin because the site occurs in a micro-alluvial fan position just below a small temporary stream. Small lenses and bands of sand also occur in the Of horizons.

Intensive Meadow Study Site - Plot 5K (See Fig. 1)

Sampling Date: August 10, 1971

Approximate Elevation and Age: 35 m AMSL; <8000 years B.P.

Slope Class and Aspect: B-C; W

Drainage Class: Very poorly drained

Parent Material: Slightly decomposed sedges and mosses

Vegetation: Hummocky sedge- moss meadow (Muc and Bliss 1976)

Subgroup Class: Fibric Organo Cryosol (Pergelic Cryofibrist)

Map Unit: 71

5-0 cm; moss layer

Of$_1$ 0-8 cm; very dark brown (10 YR 2/2 m) fibrous organic matter; abundant, very fine and fine random roots; abrupt, smooth boundary; 6 to 10 cm thick; neutral.

Of$_2$ 8-25 cm; dark reddish brown (5 YR 2/2 m) fibrous organic matter; abundant, very fine and fine random roots; abrupt, smooth boundary; 15 to 20 cm thick; slightly acid.

Oz 25 plus cm; frozen organic material.

Remarks: This individual occurs in a hummock. Of$_1$ and Of$_2$ horizons are separated on the basis of color.

Intensive Meadow Study Site - Plot 10A (See Fig. 1)

Sampling Date: August 17, 1971

Approximate Elevation and Age: 35 m AMSL; <8000 years B.P.

Slope Class and Aspect: B-C;W

Drainage Class: Very poorly drained

Parent Material: Slightly decomposed sedges and mosses

Vegetation: Hummocky sedge-moss meadow (Muc and Bliss 1976)

Subgroup Class: Fibric Organo Cryosol (Pergelic Cryofibrist)

Map Unit: 71

3-0 cm; moss layer and algae.

Of 0-25 cm; very dark brown (10 YR 2/2 m) fibrous organic matter; abundant, very fine and fine roots; abrupt, smooth boundary; 23 to 27 cm thick; medium acid.

Oz 25 plus cm; frozen organic material.

Remarks: This site occurs in an inter-hummock depression. Minor amounts of in-washed coarse sand occur in the Of horizon.

Sampling Site 18 (See Fig. 2)

Sampling Date: August 20, 1971

Approximate Elevation and Age: 15 m AMSL; <6200 years B.P.

Slope Class and Aspect: B-C; WSW

Drainage Class: Very poorly drained

Parent Material: Slightly decomposed sedges and mosses

Vegetation: Hummocky sedge-moss meadow (Muc and Bliss 1976)

Subgroup Class: Fibric Organo Cryosol (Pergelic Cryofibrist)

Map Unit: Mapped as a complex of units 83 and 31.

3-0 cm; moss layer and algae.

Of 0-20 cm; very dark brown (10 YR 2/2 m) fibrous organic matter; abundant very fine and fine roots; stones at lower boundary; few (<5%) cobbles in active layer; abrupt, smooth boundary; 18 to 22 cm thick; slightly acid.

Oz 20 plus cm; frozen organic material and crystalline stones.

Remarks: This site occurs in a small meadow surrounded (and probably underlain) by crystalline rock outcrop near the northern coastline. The profile is from an inter-hummock depression.

Sampling Site 31 (See Fig. 2)

Sampling Date: August 14, 1972

Approximate Elevation and Age: 8 m AMSL; <4400 years B.P.

Slope Class and Aspect: A-B; NW

Drainage Class: Very poorly drained

Parent Material: Slightly decomposed sedges and mosses

Vegetation: Wet sedge-moss meadow (Muc and Bliss 1976)

Subgroup Class: Fibric Organo Cryosol (Pergelic Cryofibrist)

Map Unit: 71

6-0 cm; moss layer

Of_1 0-5 cm; dark reddish brown (5 YR 2/2 m) fibrous organic matter; abundant, very fine and fine random roots; abrupt, smooth boundary; 4 to 6 cm thick; neutral.

Of_2 5-15 cm; very dark brown (10 YR 2/2 m) fibrous organic matter; abundant, very fine and fine random roots; abrupt, smooth boundary; 9 to 12 cm thick; slightly acid.

Oz 15 plus cm; frozen organic material.

Remarks: The Of_1 is more fibrous than most organic layers observed in the study area. It contains a large amount of rhizomes. The Of_2 is more decomposed, more compacted, and contains fewer rhizomes than the Of_1 horizon.
This meadow occurs where a stream has fanned out over a large, open, flat area.

Sampling Site 36 (See Fig. 2)

Sampling Date: August 19, 1972

Approximate Elevation and Age: 11 m AMSL; 6000 years B.P

Slope Class and Aspect: A; Level

Drainage Class: Very poorly drained

Parent Material: Slightly decomposed sedges and mosses

Vegetation: Wet sedge-moss meadow (Muc and Bliss 1976)

Subrgoup Class: Fibric Organo Cryosol (Pergelic Cryofibrist)

Map Unit: 71

3-0 cm; moss layer

Of_1 0-8 cm; dark reddish brown (5 YR 2/2 m) fibrous organic matter; abundant, very fine and fine roots; clear, smooth boundary; very fine roots; clear, smooth boundary; 6-10 cm thick; slightly acid.

Of_2 8-15 cm; very dark brown (10 YR 2/2 m) with some bands of dark reddish brown (5 YR 2/2 m) fibrous organic matter; abundant, very fine and fine roots; abrupt, smooth boundary; 6 to 9 cm thick; medium acid.

Oz 15 plus cm; frozen organic material.

Remarks: Site 36 and Site 9 (see text) are from the same meadow -- a wet sedge-moss meadow occurring along a stream. The Of_1 horizon is more fibrous and loose than most organic layers encountered in the study area. The Of_2 horizon is more compacted and more decomposed than the Of_1 horizon.

Sampling Site 38 (See Fig. 2)

Sampling Date: August 20, 1972

Approximate Elevation and Age: 11 m AMSL; <5700 years B.P.

Slope Class and Aspect: B; SW

Drainage Class: Very poorly drained

Parent Material: Slightly decomposed mosses and sedges overlying cobbles and stones with interstitial organic matter.

Vegetation: Hummocky sedge-moss meadow (Muc and Bliss 1976)

Subgroup Class: Fibric Organo Cryosol (Pergelic Cryofibrist)

Map Unit: 71

3-0 cm; moss layer

Of_1	0-13 cm; very dark brown (10 YR 2/2m) with bands of dark reddish brown (5 YR 2/2 m) fibrous organic matter; abundant, very fine to medium roots; abrupt, smooth boundary; 11 to 13 cm thick; neutral.
Of_2	13-25 cm; black (10 YR 2/1 m) organic matter amongst coarse fragments (about 50%) of predominantly cobble size; abundant, very fine and fine random roots; abrupt, smooth boundary; 10 to 14 cm thick.
Oz	25 plus cm; frozen organic material, cobbles, and stones.

Remarks: This profile is from a low hummock. The Of_2 horizon is more decomposed than most organic layers associated with such soils and sites. Congeliturbation appears to have operated long ago in the immediate vicinity. Frost-boils are now well stabilized and are supporting closed plant cover.

Sampling Site 2 (See Fig. 1)

Sampling Date: July 27, 1971

Approximate Elevation and Age: 11 m AMSL; <5700 years B.P.

Slope Class and Aspect: a; Level (flat top of a polygon)

Drainage Class: Moderately well to well drained

Landform and Parent Material: High centered, ice-cored polygons; fibrous, dry peat overlying ground ice.

Vegetation: Ice-wedge polygon (cushion plant) (Muc and Bliss 1976)

Subgroup Class: Glacic Fibric Organo Cryosol (Pergelic Cryofibrist)

Map Unit: 72

Of_1 0-5 cm; black (10 YR 2/1 m) fibrous organic matter; quite compact; plentiful, very fine and fine roots; abrupt, smooth boundary; 4 to 6 cm thick; strongly acid.

Of_2 5-19 cm; very dark brown (10 YR 2/2 m) fibrous organic matter; quite loose; few, very fine roots; abrupt, smooth boundary; 12 to 15 cm thick; slightly acid.

Oz 19 plus cm; frozen organic material.

Remarks: This site has low plant cover, except for lichen, and polygon tops are dessicated (cracked) to some extent. The Of_1 horizon is much more compacted than the Of 2 horizon.
This polygon field straddles a stream.

Sampling Site 4 (See Fig. 2)

Sampling Date: July 27, 1971

Approximate Elevation and Age: 8 m AMSL; 2450 years B.P. (basal peat age according to Barr 1971)

Slope Class and Aspect: c; SW (rounded top of polygon)

Drainage Class: Moderately well drained

Landform and Parent Material: High centered, ice-cored polygons; fibrous, dry peat overlying ground ice.

Vegetation: Ice-wedge polygon (cushion plant) (Muc and Bliss 1976)

Subgroup Class: Glacic Fibric Organo Cryosol (Pergelic Cryofibrist)

Map Unit: 72

1-0 cm; moss and litter layer.

Of 0-8 cm; black to very dark brown (10 YR 2/1 - 2/2 m) fibrous organic matter; abundant, very fine and fine roots; abrupt, wavy boundary; 5 to 11 cm thick; slightly acid.

Om 8-19 cm; dark grayish brown (2.5 Y 4/2 m) sedimentary organic matter; fine, granular-like structure; plentiful, very fine and fine roots; abrupt, smooth boundary; 8 to 14 cm thick; neutral.

Oz 19 plus cm; frozen sedimentary peat.

Remarks: This site is in the same polygon field as Site 1 (see text). The sedimentary peat (Om horizon) is thought to be algae -- abundant along the shoreline of Phalarope Lake immediately south of Site 4. The fresh, shperical-shaped, blue-green algal bodies are not easily visible in the Om horizon of this profile.

Sampling Site 37 (See Fig. 2)

Sampling Date: August 19, 1972

Approximate Elevation and Age: 11 m AMSL; <5700 years B.P.

Slope Class and Aspect: a; Level (flat top of polygon)

Drainage Class: Moderately well to well drained

Landform and Parent Material: High centered, ice-cored polygons; fibrous, dry peat overlying ground ice.

Vegetation: Ice-wedge polygon (cushion plant) (Muc and Bliss 1976)

Subgroup Class: Glacic Fibric Organo Cryosol (Pergelic Cryofibrist)

Map Unit: 72

Of_1 0-8 cm; black (5 YR 2/1 m) fibrous organic matter; quite compact; abundant, very fine random roots; clear, smooth boundary; 6 to 10 cm thick; medium acid.

Of_2 8-11 cm; black to dark reddish brown (5 YR 2/1 - 2/2 m) fibrous organic matter; quite loose; plentiful, very fine random roots; abrupt, smooth boundary; 2 to 4 cm thick; medium acid.

Oz 11 plus cm; frozen organic material.

Remarks: This site is from the same polygon field (adjacent to a stream) as Site 2. Plant cover, except for lichen and dried algae, is low and polygon tops are dessicated (cracked) to some extent. The Of_1 horizon is more compacted and less fibrous than the Of_2 horizon.

Table A3. Chemical and physical data for Organo Cryosols

Horizon	Depth (cm)	pH	Org. Carbon %	Total N %	$CaCO_3$ Equiv. %	Exchangeable Cations (me/100g)					T.E.C. (me/100g)	Available Nutrients (ppm)					Oxalate		% Coarse Fragments (>2mm)	Particle Size Distribution (% of <2mm fraction)			Bulk Density (gm/cc)
						H	Ca	Mg	Na	K		NO_3-N	P	K	Na	SO_4-S	Fe %	Al %		Sand (2.0 - 0.05mm)	Silt (0.05 - 0.002mm)	Clay (<0.002 mm)	
Intensive Meadow Study Site (Plot 1 La) -- Fibric Organo Cryosol in sedge-moss derived peat (wet):																							
Of	0-3	6.6	38.2	2.20	-	-	74.0	26.8	0.2	0.7	123.9	4	14	279	50	13.3	3.27	0.05	-	-	-	-	-
Of	3-6	6.3	32.3	1.90	-	17.1	70.0	23.8	0.3	0.4	106.2	0	8	129	37	10.9	0.82	0.09	-	-	-	-	-
Of	6-9	6.1	29.4	1.95	-	17.1	74.7	30.2	0.2	0.2	107.8	0	8	103	44	13.9	0.52	0.18	-	-	-	-	-
Ahg	9-12	6.2	8.9	0.76	-	8.1	25.2	9.2	0.1	0.1	40.2	0	3	21	8	11.6	0.13	0.00	-	-	-	-	-
Ahg	12-15	6.4	3.2	0.17	-	1.8	5.8	1.9	Tr	Tr	9.6	0	1	12	4	6.8	0.06	0.01	-	92	8	0	-
Ahg	15-18	6.5	2.1	0.16	-	2.3	3.7	0.6	Tr	Tr	9.2	0	1	9	3	6.6	0.05	0.00	-	94	5	1	-
Ahg	18-21	6.3	3.3	0.27	-	2.5	11.7	3.2	Tr	Tr	11.6	0	1	8	5	11.2	0.09	0.03	-	91	8	1	-
Intensive Meadow Study Site (Plot 1 Lb) -- Fibric Organo Cryosol in sedge-moss derived peat (wet):																							
Of_1	0-3	6.8	36.0	2.45	-	-	101.2	35.8	0.4	0.4	126.4	28	5	200	35	8.0	0.62	0.02	-	-	-	-	-
Of_1	3-6	6.3	32.3	2.55	-	9.5	92.4	32.1	0.4	0.3	115.5	3	3	110	27	14.5	0.44	0.17	-	-	-	-	-
Of_1	6-9	6.4	21.3	2.30	-	10.4	85.5	30.5	0.2	0.3	103.5	2	4	119	25	12.8	0.16	0.06	-	-	-	-	-
Ahg	9-12	6.4	16.2	1.88	-	10.4	64.7	17.9	0.3	0.2	87.0	2	2	51	12	12.4	0.14	0.04	-	-	-	-	-
Ahg	12-15	6.4	8.2	0.84	-	6.2	36.7	11.4	0.1	0.1	48.2	1	1	28	6	10.2	0.12	0.06	-	-	-	-	-
Ahg	15-18	6.3	6.1	0.55	-	5.1	27.0	8.5	0.1	0.1	31.0	1	1	23	5	13.3	0.11	0.02	-	-	-	-	-
Ahg	18-21	6.4	6.1	0.72	-	6.1	25.8	8.4	0.1	0.1	31.5	1	1	20	5	14.2	0.13	0.03	-	-	-	-	-
Ahg	21-24	6.2	6.7	1.01	-	7.9	40.6	12.8	0.1	0.1	47.0	1	1	17	5	12.2	0.15	0.08	-	-	-	-	-
Of_2	24-27	6.1	26.6	1.35	-	12.5	58.7	16.5	0.1	0.1	72.7	5	5	50	25	16.8	0.39	0.12	-	-	-	-	-
Intensive Meadow Study Site (Plot 5K) -- Fibric Organo Cryosol in sedge-moss derived peat (wet):																							
Of_1	0-8	6.6	36.0	2.52	-	-	90.7	28.0	0.2	0.2	115.8	4	0	129	21	5.4	0.84	0.18	-	-	-	-	-
Of_2	8-25	6.1	30.2	1.93	-	19.7	61.4	18.3	0.1	0.1	88.1	6	0	47	25	8.0	0.57	0.21	-	-	-	-	-

Table A3. Continued

Horizon	Depth (cm)	pH	Org. Carbon %	Total N %	$CaCO_3$ Equiv. %	Exchangeable Cations (me/100g)					T.E.C. (me/100g)	Available Nutrients (ppm)					Oxalate		% Coarse Fragments (>2mm)	Particle Size Distribution (% of <2mm fraction)			Bulk Density (gm/cc)
						H	Ca	Mg	Na	K		NO_3-N	P	K	Na	SO_4-S	Fe %	Al %		Sand (2.0 - 0.05mm)	Silt (0.05 - 0.002mm)	Clay (<0.002 mm)	
Intensive Meadow Study Site (Plot 10A) -- Fibric Organo Cryosol in sedge-moss derived peat (wet):																							
Of	0-25	5.9	35.9	2.59	-	24.0	72.8	22.5	0.4	0.1	108.7	0	0	39	33	17.7	0.79	0.19	-	-	-	-	-
Site 18 -- Fibric Organo Cryosol in sedge-moss derived peat (wet):																							
Of	0-20	6.3	32.4	2.83	-	17.0	75.7	21.3	0.3	0.2	99.3	2	0	48	26	28.1	0.61	0.18	-	-	-	-	-
Site 31 -- Fibric Organo Cryosol in sedge-moss derived pest (wet):																							
Of$_1$	0-5	7.0	34.8	2.15	2.1	-	57.2	25.9	0.6	0.7	103.0	-	-	-	-	-	3.74	0.02	-	-	-	-	-
Of$_2$	5-15	6.2	32.6	2.35	-	19.0	61.7	17.9	0.3	0.2	97.9	-	-	-	-	-	0.70	0.03	-	-	-	-	-
Site 36 -- Fibric Organo Cryosol in sedge-moas derived peat (wet):																							
Of$_1$	0-8	6.5	36.5	1.68	-	25.3	52.5	19.8	1.8	0.8	112.3	-	-	-	-	-	10.79	0.01	-	-	-	-	-
Of$_2$	8-15	5.9	32.2	2.51	-	24.3	50.7	15.7	0.5	0.2	96.1	-	-	-	-	-	1.45	0.06	-	-	-	-	-
Site 38 -- Fibric Organo Cryosol in sedge-moss derived peat (wet):																							
Of$_1$	0-13	6.9	34.4	2.85	-	-	73.1	31.8	0.6	0.5	114.8	-	-	-	-	-	2.50	0.05	-	-	-	-	-
Site 2 -- Glacic Fibric Organo Cryosol in dry peat overlying ground ice:																							
Of$_1$	0-5	5.5	40.8	2.90	-	28.0	63.2	21.9	2.2	0.3	114.7	200+	8	145	180	33.3	-	-	-	-	-	-	-
Of$_2$	5-19	6.2	46.5	2.74	-	25.2	84.8	29.1	1.1	0.3	125.0	5	0	40	45	13.1	-	-	-	-	-	-	-
Site 4 -- Glacic Fibric Organo Cryosol in dry peat overlying ground ice:																							
Of	0-8	6.3	32.8	2.37	-	15.1	64.2	29.4	1.2	0.2	98.7	88	8	105	100	16.2	-	-	-	-	-	-	-
Om	8-19	6.9	28.5	2.14	-	-	32.7	21.0	0.9	0.2	62.9	188	285	230	105	48.0	-	-	-	-	-	-	-
Site 37 -- Glacic Fibric Organo Cryosol in dry peat overlying ground ice:																							
Of$_1$	0-8	5.6	29.7	3.04	-	25.3	76.4	21.2	4.2	0.3	128.8	-	-	-	-	-	-	-	-	-	-	-	-
Of$_2$	8-11	6.0	42.7	2.89	-	19.9	68.4	20.5	1.1	0.3	121.5	-	-	-	-	-	-	-	-	-	-	-	-

Sampling Site 12 (See Fig. 2)

Sampling Date: August 15, 1971

Approximate Elevation and Age: 12 m AMSL; 5700 years B.P.

Slope Class and Aspect: c; SW (near the top of a raised beach)

Drainage Class: Moderately well to imperfectly drained

Landform and Parent Material: Raised beach; Bd 1 beach material

Vegetation: Cushion plant-moss community with frost-boils (Muc and Bliss 1976)

Subgroup Class: Regosolic Turbic Cryosol

Map Unit: Mapped as inclusion in map unit 11

LFH 1-0 cm; slightly to well decomposed litter occurring beneath cushion plants and mosses; 0 to 3 cm thick.

FHy 0-8 cm; black (10 YR 2/1 m) fairly well decomposed organic matter; contains small amounts of coarse sand; gravels, and cobbles; plentiful, very fine and fine roots; V-shaped horizon below trough of the patterned ground mesh; abrupt, broken boundary; 0 to 50 cm thick; 28 cm maximum horizontal width; mildly alkaline.

Cky_1 5-54 plus cm; gravelly loamy sand surrounding the FH horizon; single grain; loose; very few, very fine roots to 15 cm; about 50% gravels and 10% cobbles; abrupt, broken boundary; 0 to 38 cm thick; moderately alkaline.

Cky_2 0-58 plus cm; dark grayish brown to grayish brown (2.5 Y 4/2 to 5/2 m) loam to gravelly loam; massive; friable; few fine roots to 8 cm; very few very fine roots to 15 cm; coarse fragment (gravels and cobbles) content increases with increasing depth; abrupt, broken boundary; 0 to 58 cm thick; moderately alkaline.

Remarks: This site occupies an unusual position -- a small area of patterned ground (net) at the end of raised beach belonging to map unit 11. The FH and Cky_1 horizon occur in the trough position and the Cky_2 in the frost-boil position. The sparsely vegetated frost-boil has a thin layer (<1 cm) of gravels and lichens. Conceptually, this individual is an inclusion in map unit 41. Pedon width is about 75 cm. The frost table was not reached.

Sampling Site 23 (See Fig. 2)

Sampling Date: July 31, 1972

Approximate Elevation and Age: 23 m AMSL; 7000 years B.P.

Slope Class and Aspect: B; NW

Drainage Class: Imperfectly drained

Parent Material: Bd 1 beach material.

Vegetation: Cushion plant-moss community (Muc and Bliss 1976)

Subgroup Class: "Gleyed" Regosolic Turbic Cryosol

Map Unit: An inclusion in map unit 41.

LF 1-0cm; litter layer.

FH 0-6 cm; black (10 YR 2/1 m) organic matter; abundant, very fine to medium oblique roots; abrupt, wavy horizon; 2 to 8 cm thick; neutral.

Bmky 6-8 cm; very dark grayish brown (10 YR 3/2 m) gravelly sandy loam; some 2.5 Y 3/2 color; organic streaks; massive; very friable; plentiful, very fine and fine roots; abrupt, broken boundary; 0 to 4 cm thick.

Ckgy 8-36 cm; brown to dark yellowish brown (10 YR 4/3 - 4/4 m) gravelly sandy loam; common, coarse, faint very dark grayish brown to dark brown (10 YR 3/2 - 3/3 m) mottles; organic streaks and pockets; weak, fine subangular blocky to granular; very friable; few, fine roots to 23 cm; about 30% cobbles; abrupt, smooth boundary; 25 to 30 cm thick; moderately alkaline.

Cz 36 plus cm; frozen beach material.

Remarks: This pedon includes a fossilized (or inactive) frost-boil upon which the above horizons are weakly impressed. Active congeliturbation does occur in much of surrounding soil area. Broken horizons and organic streaking are morphologic evidence for cryoturbation in the past. Also, the frost-boil surface is not as well vegetated (% cover) as the trough. A large number of sea shells occurs in this profile. There is about 15% stones throughout the profile.

Sampling Site 19 (See Fig. 2)

Sampling Date: July 25, 1972

Approximate Elevation and Age: 79 m AMSL; 9500 years B.P.

Slope Class and Aspect: B; WSW

Drainage Class: Well drained

Landform and Parent Material: End moraine; glacial till (Tm)

Vegetation: Cushion plant-lichen with frost-boils (stripes)

Subgroup Class: Regosolic Turbic Cryosol (Pergelic Cryothent)

Map Unit: 51

LF 1-0 cm; litter layer beneath cushion plants in vegetetated stripe (trough position).

Ahky 0-19 cm; very dark brown to very dark grayish brown (10 YR 2/2 - 3/2 m) very gravelly loamy sand; single grain, loose; plentiful, very fine and fine roots; about 50% gravels (mainly fine gravels) and 20% cobbles; clear, broken boundary; V-shaped; 0-23 cm thick; about 15 cm maximum horizontal width; moderately alkaline.

Cky 0-15 cm; brown to dark yellowish brown (10 YR 4/3 - 4/4 m) gravelly sandy loam; weak, fine subangular blocky to weak, fine granular; very friable; few, very fine to fine horizontal roots; about 15% gravels, less than 5% cobbles; clear, broken boundary; 0 to 23 cm thick; moderately alkaline.

Ck 15-67 cm; yellowish brown (10 YR 5/4 m) gravelly sandy loam; weak, fine subangular blocky to weak, fine granular; very friable; about 20% gravels and 10% cobbles; abrupt, smooth boundary; 44 to 55 cm thick.

Cz 67 plus cm; frozen till.

Remarks: This site is at the top of Wolf Hill (see Fig. 1). There are about 5% surface stones at the site but other places on Wolf Hill (same soil area) have up to 70% surface stones. Pedon width for this individual is about 1 m. The LF and Ahky horizons occur in the vegetated stripe or trough position. The Cky horizon occupies the frost-boil position. On the sparsely vegetated frost-boil there is a gravel-lichen layer less than 1 cm thick. This soil is drier than modal soils of map unit 51. Dessication cracks are common on frost-boils.

Sampling Site 41 (See Fig. 2)

Sampling Date: July 31, 1971

Approximate Elevation and Age: 28 m AMSL; 7500 years B.P.

Slope Class and Aspect: c; WSW

Drainage Class: Imperfectly drained

Landform and Parent Material: Raised beach; Bd 1 beach material

Vegetation: Cushion plant-moss community with frost-boils (circles and nets) (Muc and Bliss 1976)

Subgroup Class: Brunisolic Turbic Cryosol (Pergelic Cryochrept)

Map Unit: 41

LF 1-0 cm; litter layer.

FHy 0-5 cm; black (10 YR 2/1 m) organic matter; abundant, very fine and fine roots; abrupt, broken boundary; 0 to 9 cm thick; neutral.

Bmky 5-40 cm; very dark grayish brown to dark brown (10 YR 3/2 - 3/3 m) gravelly loamy sand; single grain; very friable; plentiful very fine roots; abrupt, broken boundary; 0 to 48 cm thick; occurs as a large semi-circular pocket beneath the FHy horizon (trough position); mildly alkaline.

Cky 0-38 cm; weak red (2.5 YR 4/2 m) loam; weak, fine subangular blocky; friable; few, very fine roots; abrupt, broken boundary; 0 to 50 cm thick; occurs as a large semi-circular pocket in the frost-boil position; moderately alkaline.

Ck$_1$ 38-74 cm; dark brown to brown (10 YR 4/3 m) loamy sand to gravelly loamy sand; single grain; loose; very few, very fine roots; abrupt, wavy boundary; 23 to 56 cm thick; extends across the entire pedon beneath the Bmky and Cky horizons; only the shape of the upper boundary has been affected by congeliturbation; moderately alkaline.

Ck$_2$ 74-86 cm; gravelly loamy sand; wet; slightly sticky, slightly plastic in places; abrupt, broken boundary; 0 to 14 cm thick; occurs beneath the Ck$_1$ horizon but in the frost-boil position; moderately alkaline.

Cz 86 plus cm; frozen beach material (Ck$_1$ and Ck$_2$); occurs at 86 cm under the frost-boil; 76 cm under the trough (the trough center is about 10 cm lower than the frost-boil center at the ground surface).

Remarks: Pedon width for this individual is about 75 cm. The Cky horizon has an unusual texture relative to the rest of the profile and an unusual color relative to the other horizons and all other soils in the study area. Coarse fragments (dominated by fine gravels) are concentrated under the trough position (40-50% coarse fragments) as opposed to the frost-boil position (less than 20% coarse fragments). The exception is the Ck$_2$ horizon which has about 40% coarse fragments. A few cobbles occur throughout. Some stones were encountered at the frost table.

Sampling Site 28 (See Fig. 2)

Sampling Date: August 9, 1972

Approximate Elevation and Age: 15 m AMSL; <6200 years B.P.

Slope Class and Aspect: c; SW

Drainage Class: Imperfectly drained

Landform and Parent Material: Small raised beach; Bd 1 beach material

Vegetation: Cushion plant-moss community with frost-boils (circles and nets) (Muc and Bliss 1976).

Subgroup Class: Brunisolic Turbic Cryosol (Pergelic Cryochrept)

Map Unit: 41

LF 2-0 cm; litter layer; 0 to 3 cm thick.

FHy 0-6 cm; black to very dark brown (10 YR 2/1 - 2/2 m) organic matter; plentiful, very fine to medium random roots to 18 cm; abrupt, broken boundary; 0 to 8 cm thick under frost-boil/trough margin, 8 to 25 cm thick in trough position where it is V-shaped; mildly alkaline.

ABy 6-33 cm; light brownish gray to grayish brown (2.5 Y 5.5/2 m) sandy loam; massive; very friable; few, very fine and fine roots to 18 cm; abrupt, broken boundary; 0 to 8 cm thick under frost-boil/trough margin, 0 to 25 cm thick in trough; occurs as a band below and around (beside) the FH horizon; maximum band width is 14 cm; some dark brown (7.5 YR 3/2 m) mottles; mildly alkaline.

Bmky 6-33 cm; dark brown to brown (7.5 YR 4/4 m) sandy loam, massive; very friable; very few, very fine and fine roots to 24 cm; contains few (about 10%) gravels; abrupt, broken boundary; occurs as a band below and beside the ABy horizon and has grayish streaks from that horizon; maximum band width is 10 cm; moderately alkaline.

Cky$_1$ 0-23 cm; yellowish brown (10 YR 5/6 m) sandy loam; common, coarse, faint yellowish brown (10 YR 5/8 m and 10 YR 5/4 m) mottles (or pockets and bands); massive; very friable; few, fine roots; gradual, broken boundary; 20 to 25 cm thick under frost-boil; moderately alkaline.

Cky$_2$ 23-43 cm; yellowish brown (10 YR 5/4 m) sandy loam; also pockets (mottles) of 10 YR 5/6 and 10 YR 5/8 colors; massive; very friable; slightly more compact than Cky$_1$ horizon; contains few more coarse fragments (mainly gravels) than Cky$_1$ horizon; abrupt, smooth boundary; 18 to 23 cm thick under frost-boil; moderately alkaline.

Cz 43 plus cm; frozen beach material plus Bmky and ABy horizons where they extend into the frozen layer under trough and frost-boil/trough positions; at 43 cm under the frost-boil, at 33 cm under the slightly depressed trough.

Remarks: This individual is somewhat unique among soils of the study area. It has a horizon (Bmky) with relatively strong coloring and another (ABy) that resembles an eluviated horizon from temperate or boreal latitudes. In addition, the horizons are highly contorted and streaked, one into another. The ABy hori-

zon consists of well sorted mineral material (fine sandy loam). Pedon width for this individual is about 1 m. Closed plant cover occurs on 50-60% of the surface.

Sampling Site 14 (See Fig. 2)

Sampling Date: August 18, 1971

Approximate Elevation and Age: 10m AMSL; <5700 years B.P.

Slope Class and Aspect: A; Level

Drainage Class: Poorly drained

Landform and Parent Material: Undifferentiated plain; undifferentiated (Un) material

Vegetation: Frost-boil sedge-moss meadow (Muc and Bliss 1976)

Subgroup Class: Gleysolic Turbic Cryosol (Pergelic Cryaquept)

Map Unit: 61

14-10 cm; moss layer; 0 to 5 cm thick.

Ofy 10-0 cm; very dark brown (10 YR 2/2 m) fibrous organic matter; abundant, very fine and fine roots; abrupt, broken boundary; 0 to 31 cm thick; a long, narrow tongue extends to 31 cm under the center of the vegetated portion; neutral.

Bgy 0 to 10 cm; dark brown to brown (10 YR 4/3 m) sandy loam; massive; nonsticky, nonplastic; few, very fine and fine roots; abrupt, broken boundary; obliquely oriented as a narrow, short band beside the tongue of Ofy horizon; mildly alkaline.

Ckg 10 to 46 cm; olive (5 Y 5/3 m) sandy loam; massive; slightly sticky; nonplastic; very few, very fine roots to 14 cm; about 25% gravels and cobbles; abrupt, smooth lower boundary; 0 to 25 cm thick; occurs beneath the vegetated portion under the Ofy and Bgy horizons; indistinct boundary with the Ckgy horizon to the side; moderately alkaline.

Ckgy 0-56 cm; olive (5 Y 5/3 m) loam; somewhat thixotropic; slightly sticky, nonplastic; few, very fine roots to 15 cm; about 10% gravels and cobbles; abrupt, smooth lower boundary (frost table); 0 to 60 cm thick; occupies the frost-boil position; abrupt boundary with Ofy and Bgy horizons; indistinct boundary with Ckg horizon; moderately alkaline.

Cz 56 plus cm; frozen undifferentiated material (Ckgy and Ckg horizons); at 56 cm from the ground surface across the pedon.

Remarks: Pedon width is about 1 m. When disturbed (by digging) the Ckgy horizon flows. The presence of a Bgy horizon is unusual for such soils as is the tonguing of the Ofy horizon. Normally, the vegetated part of a net mesh such as this is raised above the frost-boil. The difference in micro-relief at this site is very slight. The frost-boil has on its surface about 1 cm of litter and algae.

Table A4. Chemical and physical data for Turbic Cryosols

Horizon	Depth (cm)	pH	Org. Carbon %	Total N %	$CaCO_3$ Equiv. %	Exchangeable Cations (me/100g)					T.E.C. (me/100g)	Available Nutrients (ppm)					Oxalate		% Coarse Fragments (>2mm)	Particle Size Distribution (% of <2mm fraction)			Bulk Density (gm/cc)
						H	Ca	Mg	Na	K		NO_3-N	P	K	Na	SO_4-S	Fe %	Al %		Sand (2.0 - 0.05mm)	Silt (0.05 - 0.002mm)	Clay (<0.002 mm)	
Site 12 -- Regosolic Turbic Cryosol in Bd 1 beach material:																							
FHy	0-8	7.5	24.0	1.42	10.8	-	83.9	32.9	0.9	0.2	98.0	23	0	112	87	5.8	0.45	0.03	-	-	-	-	-
Cky_1	5-54	7.9	0.5	0.06	48.8	-	-	-	-	-	-	1	1	9	4	1.5	0.22	0.02	-	84	12	4	-
Cky_2	0-58	7.9	0.0	0.01	41.2	-	-	-	-	-	-	1	0	4	6	2.3	0.38	0.02	-	51	37	12	-
Site 23 -- Regosolic Turbic Cryosol in Bd 1 beach material:																							
FH	0-6	7.1	31.4	2.85	2.1	-	118.0	28.7	0.3	0.4	152.1	-	-	-	-	-	0.43	0.01	-	-	-	-	-
Ckgy	8-36	8.0	0.0	0.06	23.1	-	-	-	-	-	-	-	-	-	-	-	0.44	0.02	-	62	26	12	-
Site 19 -- Regosolic Turbic Cryosol in glacial till (Tm):																							
Ahky	0-19	8.0	2.9	0.22	25.4	-	-	-	-	-	-	-	-	-	-	-	0.26	0.02	66	82	13	5	1.4
Cky	0-15	8.2	0.0	0.01	36.3	-	-	-	-	-	-	-	-	-	-	-	0.42	0.01	20	63	32	5	1.5
Ck	15-67	8.3	0.1	0.01	33.7	-	-	-	-	-	-	-	-	-	-	-	0.42	0.02	29	66	29	5	1.5
Site 41 -- Brunisolic Turbic Cryosol in Bd 1 beach material:																							
FHy	0-5	7.1	19.7	1.40	2.5	-	85.6	22.6	0.1	0.3	91.2	31	2	102	11	3.8	0.16	0.03	-	-	-	-	-
Bmky	5-40	7.7	2.2	0.06	12.3	-	-	-	-	-	-	2	0	10	1	2.0	0.09	0.00	-	81	15	4	-
Cky	0-38	7.9	0.1	0.04	10.8	-	-	-	-	-	-	1	0	40	2	2.0	0.15	0.07	-	47	35	18	-
Ck_1*	51-76	8.0	0.4	0.03	16.1	-	-	-	-	-	-	1	1	11	1	1.5	0.10	0.00	-	86	9	5	-
Ck_1†	38-74	7.8	0.3	0.02	16.4	-	-	-	-	-	-	0	0	13	1	1.5	0.13	0.00	-	79	17	4	-
Ck_2	74-86	8.0	0.2	0.02	18.6	-	-	-	-	-	-	1	1	12	2	5.4	0.16	0.01	-	79	16	5	-

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* Sampled in the trough position below the Bmky horizon

† Sampled in the frost-boil position below the Cky horizon

Table A4. Continued

Horizon	Depth (cm)	pH	Org. Carbon %	Total N %	$CaCO_3$ Equiv. %	Exchangeable Cations (me/100g)					T.E.C. (me/100g)	Available Nutrients (ppm)					Oxalate		% Coarse Fragments (>2mm)	Particle Size Distribution (% of <2mm fraction)			Bulk Density (gm/cc)
						H	Ca	Mg	Na	K		NO_3-N	P	K	Na	SO_4-S	Fe %	Al %		Sand (2.0 - 0.05mm)	Silt (0.05 - 0.002mm)	Clay (<0.002 mm)	
Site 28 -- Brunisolic Turbic Cryosol in Bd 1 beach material:																							
FHy*	0–25	7.6	29.0	1.78	13.2	-	-	-	-	-	-	-	-	-	-	-	0.40	0.01	-	-	-	-	-
FHy†	0–3	7.5	22.3	1.40	14.0	-	84.8	23.6	0.7	0.7	106.6	-	-	-	-	-	0.31	0.01	-	-	-	-	-
ABy*	13–33	7.7	-	-	35.8	-	-	-	-	-	-	-	-	-	-	-	0.37	Tr	-	69	24	7	-
ABy†	3–10	7.7	0.0	0.04	33.8	-	-	-	-	-	-	-	-	-	-	-	0.20	Tr	-	72	28	6	-
Bmky	6–33	7.9	-	-	33.7	-	-	-	-	-	-	-	-	-	-	-	0.76	0.01	-	63	28	9	-
Cky_1	0–23	8.0	0.4	0.04	31.9	-	-	-	-	-	-	-	-	-	-	-	0.26	Tr	-	65	26	9	-
Cky_2	23–43	7.9	-	-	35.1	-	-	-	-	-	-	-	-	-	-	-	0.58	0.01	-	68	23	9	-
Site 14 -- Gleysolic Turbic Cryosol in undifferentiated material:																							
Ofy	10–0	6.9	20.2	1.90	-	-	70.3	26.0	0.7	0.2	88.3	8	0	142	73	21.1	0.76	0.06	-	-	-	-	-
Bgy	0–10	7.7	0.4	0.06	31.6	-	-	-	-	-	-	1	0	21	4	5.8	0.42	0.01	-	65	30	5	-
Ckg	10–46	7.9	0.0	0.02	42.7	-	-	-	-	-	-	0	0	36	8	6.6	0.47	0.04	-	58	34	8	-
Ckgy	0–56	8.0	0.2	0.01	39.4	-	-	-	-	-	-	1	0	56	6	2.9	0.44	0.02	-	44	43	13	-

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* Sampled in the trough position

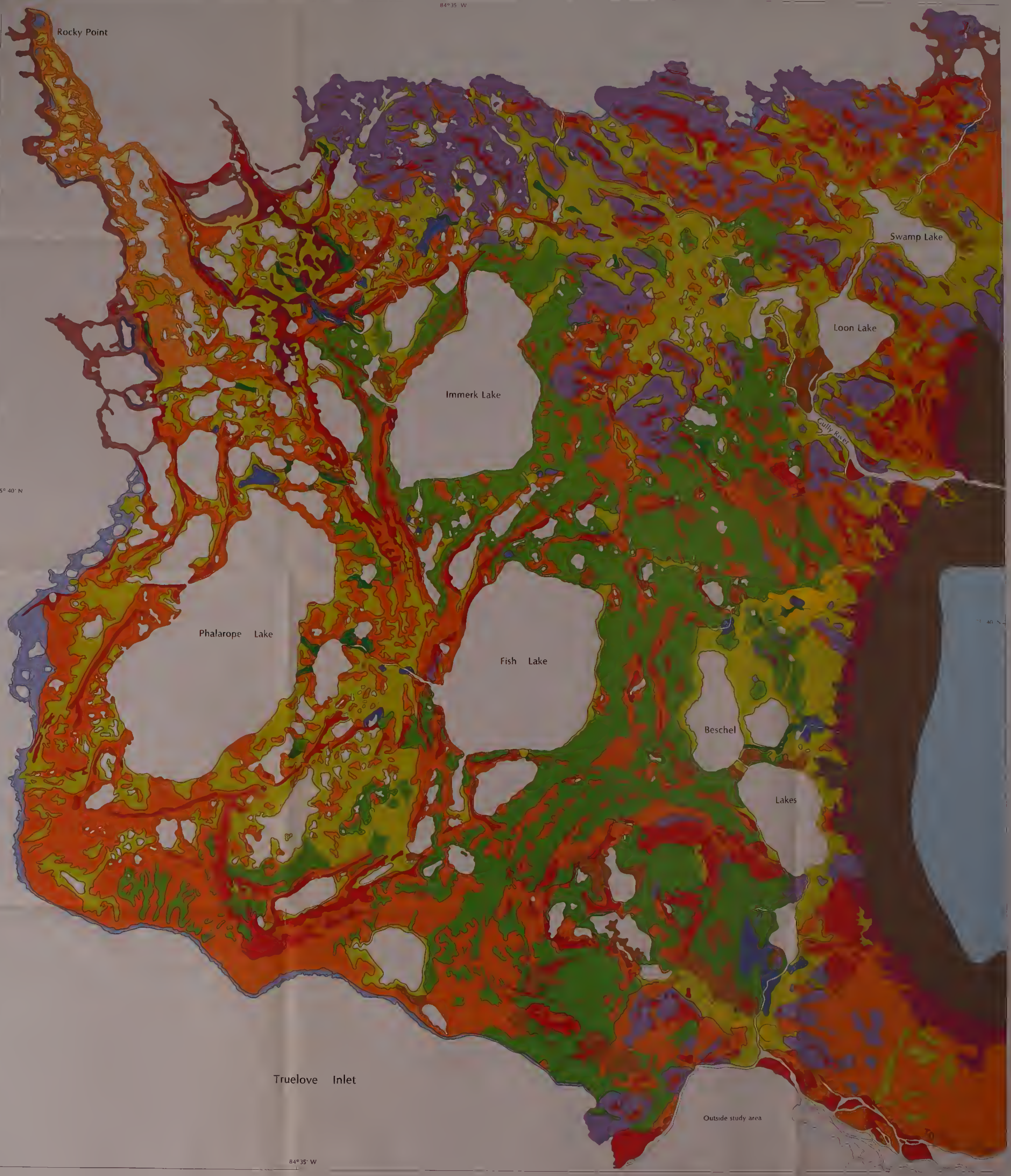
† Sampled below the trough (vegetated portion)/frost-boil margin

PLANT COMMUNITIES OF TRUELOVE LOWLAND
Devon Island, N.W.T.

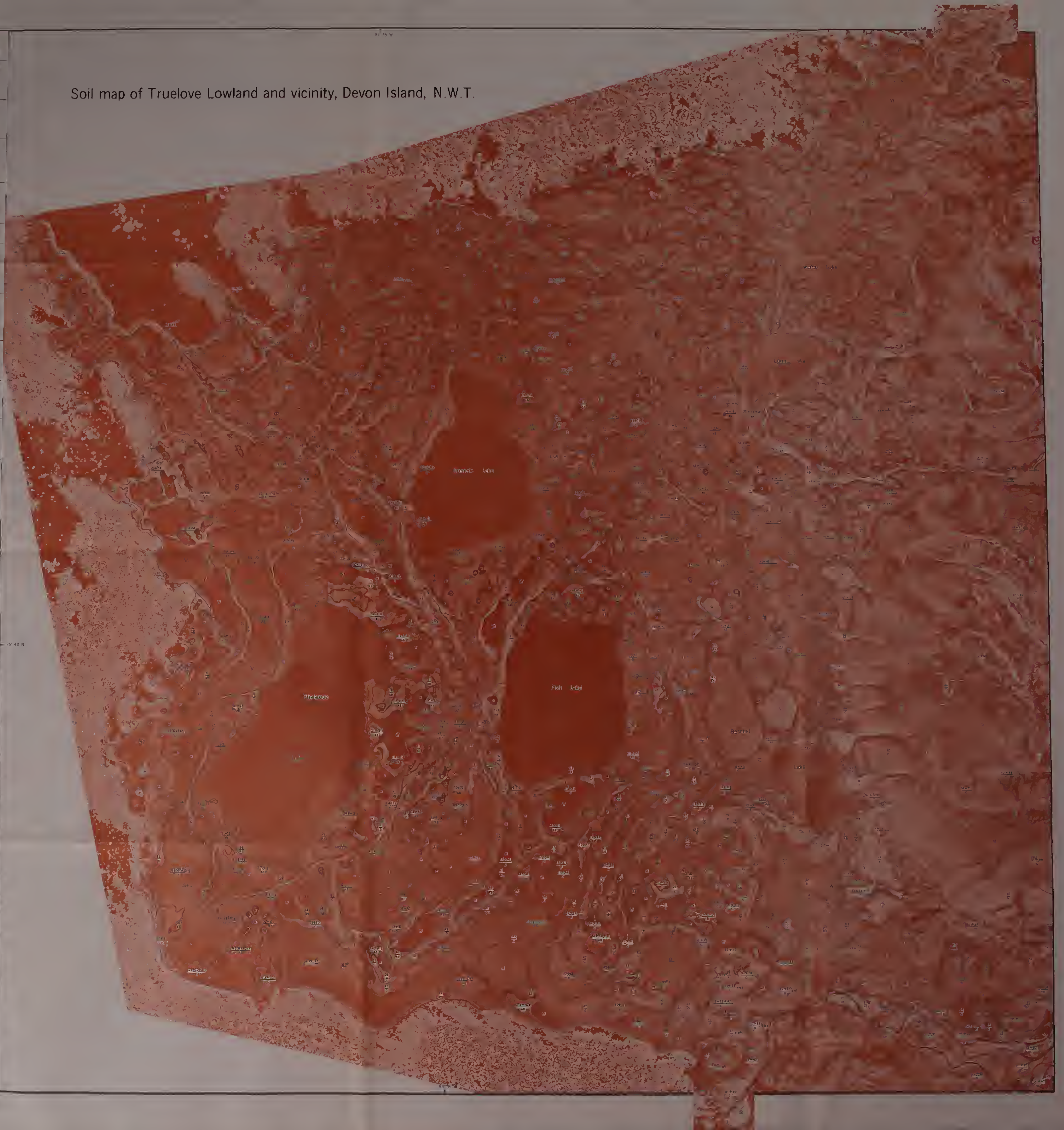
Hummocky-sedge-moss meadow	🟩
Wet sedge-moss meadow	🟩
Frost-boil sedge-moss meadow	🟩
Hummocky-graminoid meadow	🟨
Graminoid-moss meadow	🟨
Herb-moss snowbed	🟪
Dwarf shrub heath-moss (rock outcrop)	🟪
Tidal salt marsh	🟦
Ice-wedge polygons	🟦
Cushion plant-lichen (raised beach)	🟥
Cushion plant-moss (raised beach)	🟧
Cushion plant-moss with frost-boils (separate from raised beach)	🟫
Cushion plant-lichen (limestone pavement)	🟧
Cushion plant-lichen (rubble)	🟥
Unvegetated coastal shoreline	🟫
Unvegetated scree slope	🟫
Moss-herb (Polar Desert)	🟦

0 1000 metres

Map developed by Dr. Mike MUC, and prepared by the Cartographic Section, Department of Geography, University of Alberta
Base map developed from photography flown at 3030 m via stereo-orthophotographs prepared by Space Optic Ltd., Ottawa, with the field and laboratory help of personnel from the Photogrammetric Branch, National Research Council of Canada



Soil map of Truelove Lowland and vicinity, Devon Island, N.W.T.



MAP UNIT	DOMINANT SOIL			ASSOCIATED SOIL			LANDFORM	DRAINAGE CLASS[3]	ASSOCIATED PERIGLACIAL FEATURES	ASSOCIATED VEGETATION[4]
	Subgroup class[1]	Parent material[2]	Texture[3]	Subgroup class[1]	Parent material[2]	Texture[3]				
11	Brunisolic Static Cryosol	Moderately alkaline moderately to strongly calcareous beach deposit (Bd 1)	Coarse skeletal	Regosolic Static Cryosol	Moderately alkaline moderately to strongly calcareous beach deposit (Bd 1)	Coarse skeletal	Raised beach (ridge)	1	Occasional ice wedge fissures	Cushion plant lichen community (slope zone)
12	Brunisolic Static Cryosol	Moderately alkaline moderately to strongly calcareous beach deposit (Bd 1)	Coarse skeletal to very coarse				Raised beach (ridge)	1	Occasional ice wedge fissures	Cushion plant moss community
13	Brunisolic Static Cryosol	Neutral to mildly alkaline weakly to non calcareous beach deposit (Bd 2)	Coarse skeletal				Beach veneer over crystalline bedrock	1 3		Cushion plant lichen and cushion plant moss communities
21	Regosolic Static Cryosol	Moderately alkaline moderately to strongly calcareous beach deposit (Bd 1)	Coarse skeletal	Brunisolic Static Cryosol	Moderately alkaline moderately to strongly calcareous beach deposit (Bd 1)	Coarse skeletal	Raised beach (ridge)	1	Occasional ice wedge fissures	Cushion plant lichen community (crest zone)
22	Regosolic Static Cryosol	Fluvial outwash (Ow 2)	Coarse skeletal				Rolling outwash plain	1 2		Cushion plant lichen community to lichen barren
31	Gleysolic Static Cryosol	Mildly to moderately alkaline strongly to very strongly calcareous undifferentiated deposit (Un)	Moderately coarse	Fibric Organo Cryosol	Slightly acid to neutral fibrous organic material (wet)		Undifferentiated plain	6 5	Occasional ice wedge fissures	Hummocky sedge moss meadow community
32	Gleysolic Static Cryosol	Medium acid to neutral weakly to non calcareous alluvial lacustrine deposit (As)	Medium to fine				Alluvial lacustrine plain	5 6	Occasional ice wedge fissures	Hummocky sedge moss meadow community
33	Gleysolic Static Cryosol	Mildly alkaline extremely calcareous alluvium (Av 1) over other deposits					Localized floodplain over other landforms	6 5		Wet sedge-moss meadow community
34	Gleysolic Static Cryosol	Moderately alkaline very strongly calcareous glacial till (Tm)	Moderately coarse to coarse-skeletal				Lateral moraine	5		Hummocky sedge-moss meadow community
41	Brunisolic Turbic Cryosol	Moderately alkaline moderately to strongly calcareous beach deposit (Bd 1)	Coarse				Raised beach	4	Patterned ground (nets, circles and stripes)	Cushion plant moss community with frost boils
42	Brunisolic Turbic Cryosol	Moderately alkaline moderately to strongly calcareous beach deposit (Bd 1)	Coarse skeletal	Regosolic Turbic Cryosol	Moderately alkaline moderately to strongly calcareous beach deposit (Bd 1)	Coarse skeletal	Raised beach	4	Patterned ground (nets and stripes) some gelifluction	Cushion plant moss community with frost boils
51	Regosolic Turbic Cryosol	Moderately alkaline very strongly calcareous glacial till (Tm)	Coarse skeletal to coarse	Brunisolic Turbic Cryosol	Moderately alkaline very strongly calcareous glacial till (Tm)	Coarse skeletal to coarse	Terminal and lateral moraine	4 3	Patterned ground (nets and stripes) gelifluction	Cushion plant moss to cushion plant lichen communities with frost boils
61	Gleysolic Turbic Cryosol	Mildly to moderately alkaline strongly to very strongly calcareous undifferentiated deposit (Un)	Moderately coarse				Undifferentiated plain	5 6	Patterned ground (nets, circles and stripes)	Frost boil sedge moss meadow community
62	Gleysolic Turbic Cryosol	Mildly alkaline, extremely calcareous glacial till (Tg)	Medium to moderately fine				Ground moraine	5 4	Patterned ground (stripes) some gelifluction	Moss herb (Polar Desert)
71	Fibric Organo Cryosol	Slightly acid to neutral fibrous organic material (wet)		Gleysolic Static Cryosol	Mildly to moderately alkaline strongly to very strongly calcareous undifferentiated deposit (Un)	Moderately coarse	Undifferentiated plain	6 5	Occasional ice-wedge fissures	Wet and hummocky sedge moss meadow communities
72	Glacic Fibric Organo Cryosol	Medium to slightly acid *in situ* and sedimentary organic material (dry)					High-centred ice-cored polygons	3-7	Ground ice and ice wedge fissures in polygonal pattern	Cushion plant-lichen to hummocky sedge moss meadow communities
81	Regosolic Static Cryosol	Dolomitic beach rubble (Bd 3)	Fragmental	Regosolic Static Cryosol	Dolomitic beach rubble over moderately alkaline extremely calcareous beach deposit (Bd 3)	Fragmental over coarse skeletal	Raised beach (ridge)	1	Occasional ice wedge fissures	Cushion plant-lichen community
82	Regosolic Static Cryosol	Beach rubble (Bd 4)	Fragmental				Present beach and tideland			Tidal salt marsh
83	Bedrock	Consolidated crystalline rock (Rc 1)		Lithic Regosolic Static Cryosol	Neutral to mildly alkaline weakly to non calcareous	Coarse skeletal	Crystalline rock outcrop	3	Frost shattering	Cushion plant lichen + dwarf shrub heath moss community
84	Bedrock	Consolidated limestone bedrock (Rl)					Limestone plain		Frost shattering	Cushion plant lichen > cushion plant-moss community
85	Regosolic Static Cryosol	Outwash (Ow 1)	Fragmental				Active stream channel			Lichen barren
86	Regosolic Static Cryosol	Alluvial deposit (Av 2)	Fragmental				Alluvial cone			Lichen barren
87	Regosolic Static Cryosol	Colluvium (Cv)	Fragmental				Escarpment			Lichen barren
88	Regosolic Turbic and Static Cryosols	Bouldery till (Tg)	Fragmental				Ground moraine		Rock circles	Moss-herb (Polar Desert)

MAP UNIT DENOMINATORS indicate slope classes as defined by C.S.S.C. (1970). In this study complex and simple slopes are not differentiated. As a general rule complex slopes are associated with raised beach landforms (map units 11, 13, and to a lesser extent, 12 and 42), outwash (map unit 22), till (map unit 51) and many map units geographically associated with crystalline rock outcrops (map unit 83). Because of extreme slope complexity, slope classes are not provided for map unit 83. In summary, the slope class for any soil area attempts to indicate the dominant or overall slope. Slope classes and symbols are as follows:

Slope Class Symbol	Percent Slope
AB	0-2
C	2-5
D	5-9
E	9-15
F	15-30
G	30-60
H	>60

MAP UNIT MODIFIER "s" indicates soil areas with an overabundance of surface stones relative to the concepts of the appropriate map units. Usually this useage signifies 40% or more of surface stones. Modifier "s" is not used with map units 42, 51, 82, 85, 86, 87 and 88 as they are inherently very stony. Map units 11, 13, 21, 22 and 81 may occasionally be exceptionally cobbly but such a situation is not indicated on the map.

MAP UNIT "W" indicates waterbodies (lakes and ponds).

FOOTNOTES

1. Soil subgroups (tentative) as defined by Canada Soil Survey Committee (1973). See Table 6 in text for correlation with other classification systems.
2. See Table 2 in text for additional information on parent materials.
3. Soil family texture classes and drainage classes as defined by Canada Soil Survey Committee (1970). Drainage class symbols and classes are as follows: 1-rapidly drained, 2-well drained, 3-moderately well drained, 4-imperfectly drained, 5-poorly drained, and 6-very poorly drained.
4. Plant communities according to Muc and Bliss (1976).

Map developed by DR. BRUCE WALKER, prepared by the Cartographic Section, Department of Geography, University of Alberta. Base map developed from photography flown at 3030 m via stereo orthophotographs prepared by Space Optic Ltd., Ottawa, with the field and laboratory help of personnel from the Photogrammetric Branch, National Research Council of Canada.

0 — 1 000 metres

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